Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
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Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client **RF Safety Lab**
Catonsville, USA

Certificate No. **D3700V2-1130_Oct23**

CALIBRATION CERTIFICATE

Object: D3700V2 - SN:1130

MAB 11/20/23

Calibration procedure(s): QA CAL-22.v7
Calibration Procedure for SAR Validation Sources between 3-10 GHz

Calibration date: October 12, 2023

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP2	SN: 104778	30-Mar-23 (No. 217-03804/03805)	Mar-24
Power sensor NRP-Z91	SN: 103244	30-Mar-23 (No. 217-03804)	Mar-24
Power sensor NRP-Z91	SN: 103245	30-Mar-23 (No. 217-03805)	Mar-24
Reference 20 dB Attenuator	SN: BH9394 (20k)	30-Mar-23 (No. 217-03809)	Mar-24
Type-N mismatch combination	SN: 310982 / 06327	30-Mar-23 (No. 217-03810)	Mar-24
Reference Probe EX3DV4	SN: 3503	07-Mar-23 (No. EX3-3503_Mar23)	Mar-24
DAE4	SN: 601	03-Oct-23 (No. DAE4-601_Oct23)	Oct-24

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-22)	In house check: Oct-24
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24

	Name	Function	Signature
Calibrated by:	Paulo Pina	Laboratory Technician	
Approved by:	Sven Kühn	Technical Manager	

Issued: October 12, 2023

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

c) DASY System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	3700 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	37.7	3.12 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.7 ± 6 %	3.09 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	---	---

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.65 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**66.6 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.45 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.5 W/kg ± 19.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	51.0	3.55 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.8 ± 6 %	3.49 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	---	---

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	6.25 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**62.9 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.29 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.0 W/kg ± 19.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	46.0 Ω + 4.4 jΩ
Return Loss	- 24.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.1 Ω + 6.1 jΩ
Return Loss	- 21.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.129 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

DASY5 Validation Report for Head TSL

Date: 12.10.2023

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 3700 MHz; Type: D3700V2; Serial: D3700V2 - SN:1130

Communication System: UID 0 - CW; Frequency: 3700 MHz
Medium parameters used: f = 3700 MHz; σ = 3.09 S/m; ε_r = 37.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

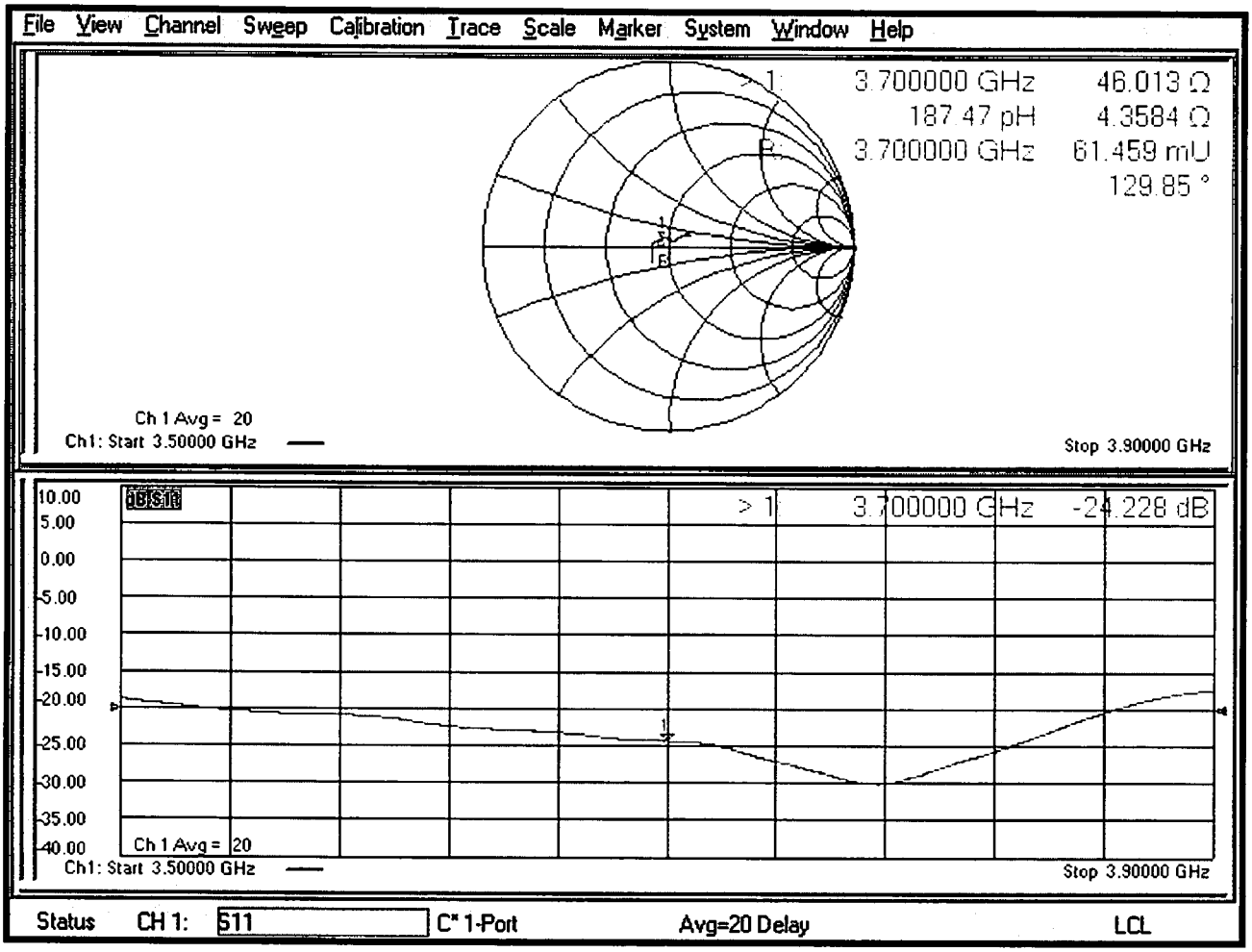
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(7.73, 7.73, 7.73) @ 3700 MHz; Calibrated: 07.03.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 03.10.2023
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Head Tissue/Pin=100 mW, d=10mm, f=3700MHz/Zoom Scan, dist=1.4mm (8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.63 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 18.5 W/kg
SAR(1 g) = 6.65 W/kg; SAR(10 g) = 2.45 W/kg
Smallest distance from peaks to all points 3 dB below = 8 mm
Ratio of SAR at M2 to SAR at M1 = 74.1%
Maximum value of SAR (measured) = 12.8 W/kg

0 dB = 12.8 W/kg = 11.06 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 10.10.2023

Test Laboratory: SPEAG, Zurich, Switzerland

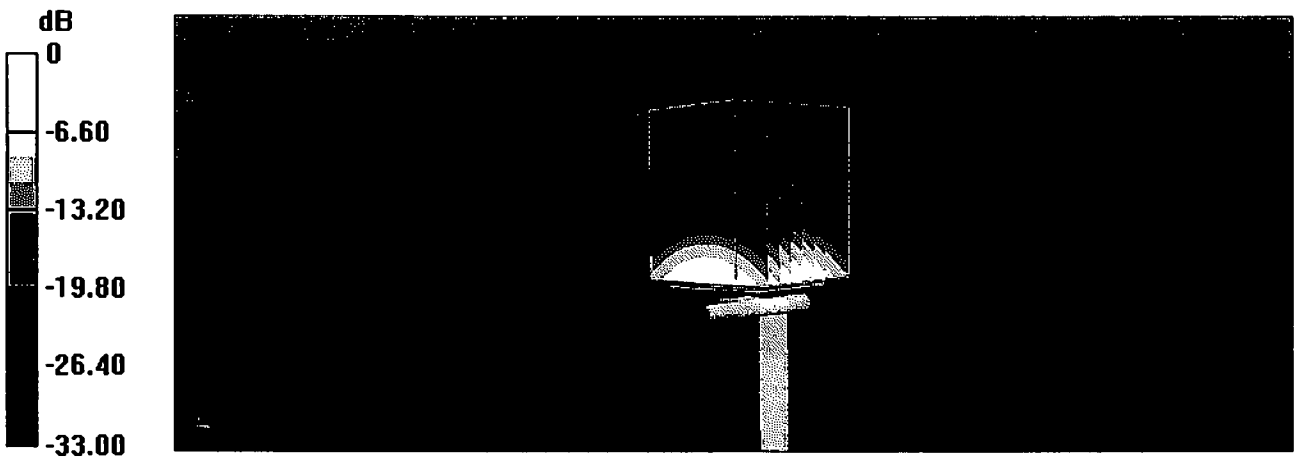
DUT: Dipole 3700 MHz; Type: D3700V2; Serial: D3700V2 - SN:1130

Communication System: UID 0 - CW; Frequency: 3700 MHz
Medium parameters used: f = 3700 MHz; σ = 3.49 S/m; ε_r = 51.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

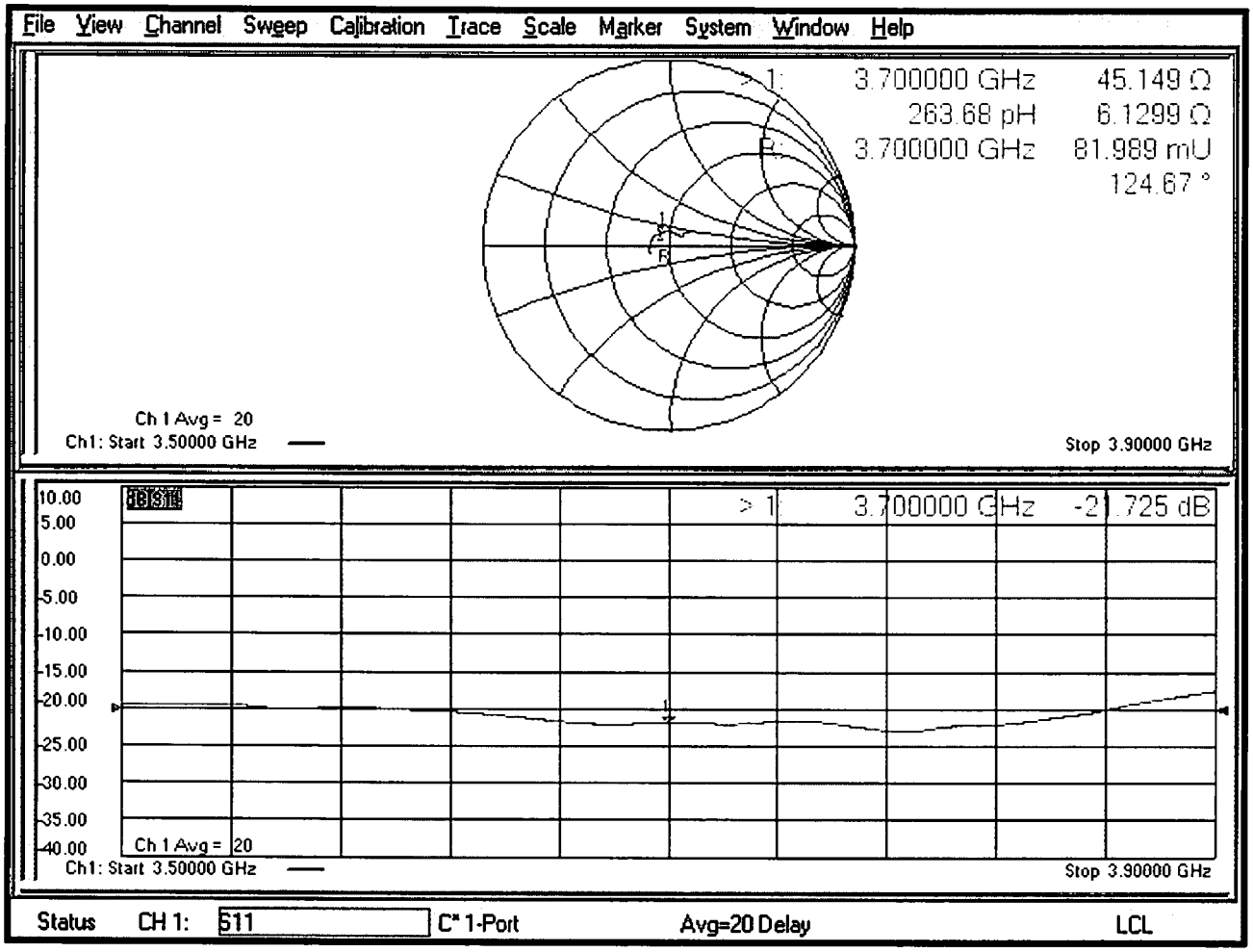
- Probe: EX3DV4 - SN3503; ConvF(7.31, 7.31, 7.31) @ 3700 MHz; Calibrated: 07.03.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 03.10.2023
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Body Tissue/Pin=100 mW, d=10mm, f=3700MHz/Zoom Scan , dist=1.4mm (8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 62.60 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 16.7 W/kg
SAR(1 g) = 6.25 W/kg; SAR(10 g) = 2.29 W/kg
Smallest distance from peaks to all points 3 dB below = 8 mm
Ratio of SAR at M2 to SAR at M1 = 75.6%
Maximum value of SAR (measured) = 11.8 W/kg



0 dB = 11.8 W/kg = 10.74 dBW/kg

Impedance Measurement Plot for Body TSL



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IN-HOUSE SAR VERIFICATION SOURCE CALIBRATION EXTENSION

Object	D3700V2 – SN: 1130
Description	SAR Validation Dipole at 3700 MHz
Procedure (s)	Procedure for SAR Verification Source Calibration Extension
In-house Check Date	11/7/2024

Equipment List

Manufacturer	Model	Description	Serial Number	Calibration Date	Calibration Due	CBT
Rohde & Schwarz	ZNL20	Vector Network Analyzer	101202	9/12/2024	9/12/2025	
Rohde & Schwarz	ZN-Z135	Calibration Kit	5000-309192839	10/31/24	10/31/26	
Control Company	4040	Ambient Thermometer	230581657	8/28/2023	8/28/2025	
Control Company	4352	Long Stem Liquid Thermometer	230662223	9/28/2023	9/28/2025	
Micro-Coax	UFB205A-0-0240-30x30	SMA M-F RF test Cable (DC - 18 GHz)	-			✓
Mini-Circuits	BW-N20W20+	20dB RF Fixed Attenuator (DC - 18 GHz)	-			✓
Mini-Circuits	NF-SF50+	RF Adapter N Male to SMA Female (DC - 18 GHz)	-			✓
SPEAG	DAE4ip	Data Acquisition Electrionics with Integ. Power	1839	8/14/2024	8/14/2025	
SPEAG	DAK-3.5	DAK-3.5 Dielectric Probe	1349	9/2/2024	9/2/2025	
SPEAG	EX3DV4	SAR Measurement Probe	7836	3/15/2024	3/15/2025	
SPEAG	Powersource1	Signal Generator	4341	1/5/2024	1/5/2025	

CBT: Components calibrated before testing. Prior to testing, the measurement paths containing a cable, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator, power sensor, or VNA) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.

Measurement Uncertainty = ±27% (k=2)

	Name	Function	Signature
Tested By:	Yue Li	Engineer	
Approved By:	Phuong Nguyen	Technical Manager	

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Per FCC KDB Publication 865664 D01, dipole can have longer calibration intervals of up to three years when it is demonstrated that the SAR target, impedance and return loss of the dipole have remained stable according to the following requirements:

1. Measured SAR does not deviate from the calibrated SAR value by more than 10%.
2. Return loss does not deviate by more than 20% from the previous measurement (i.e. value in dB x 0.2) and meet the required minimum return-loss.
3. Real and imaginary part of the impedance do not deviate by more than 5 Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have an extended calibration interval:

Dipole SN	Freq (MHz)	In-house Check Date	Cal Date	Head SAR target (1g) @ 30dBm (W/kg)	Measured Head SAR (1g) @ 17dBm (W/kg)	1g SAR Deviation (%)	Head SAR target (10g) @ 30dBm (W/kg)	Measured Head SAR (10g) @ 17dBm (W/kg)	10g SAR Deviation (%)	Cert Head Impedance (Ohm) - Real	Measured Head Impedance (Ohm) - Real	Head Impedance Deviation (Ohm) - Real	Cert Head Impedance (Ohm) - Imaginary	Measured Head Impedance (Ohm) - Imaginary	Head Impedance Deviation (Ohm) - Imaginary	Cert Head Return Loss (dB)	Measured Head Return Loss (dB)	Return Loss Deviation (%)	PASS/FAIL
1130	3700	11/7/2024	10/12/2023	66.6	3.11	-6.83%	24.5	1.16	-5.53%	46.0	47.1	1.1	4.4	5.2	0.8	-24.2	-24.3	-1.60%	PASS

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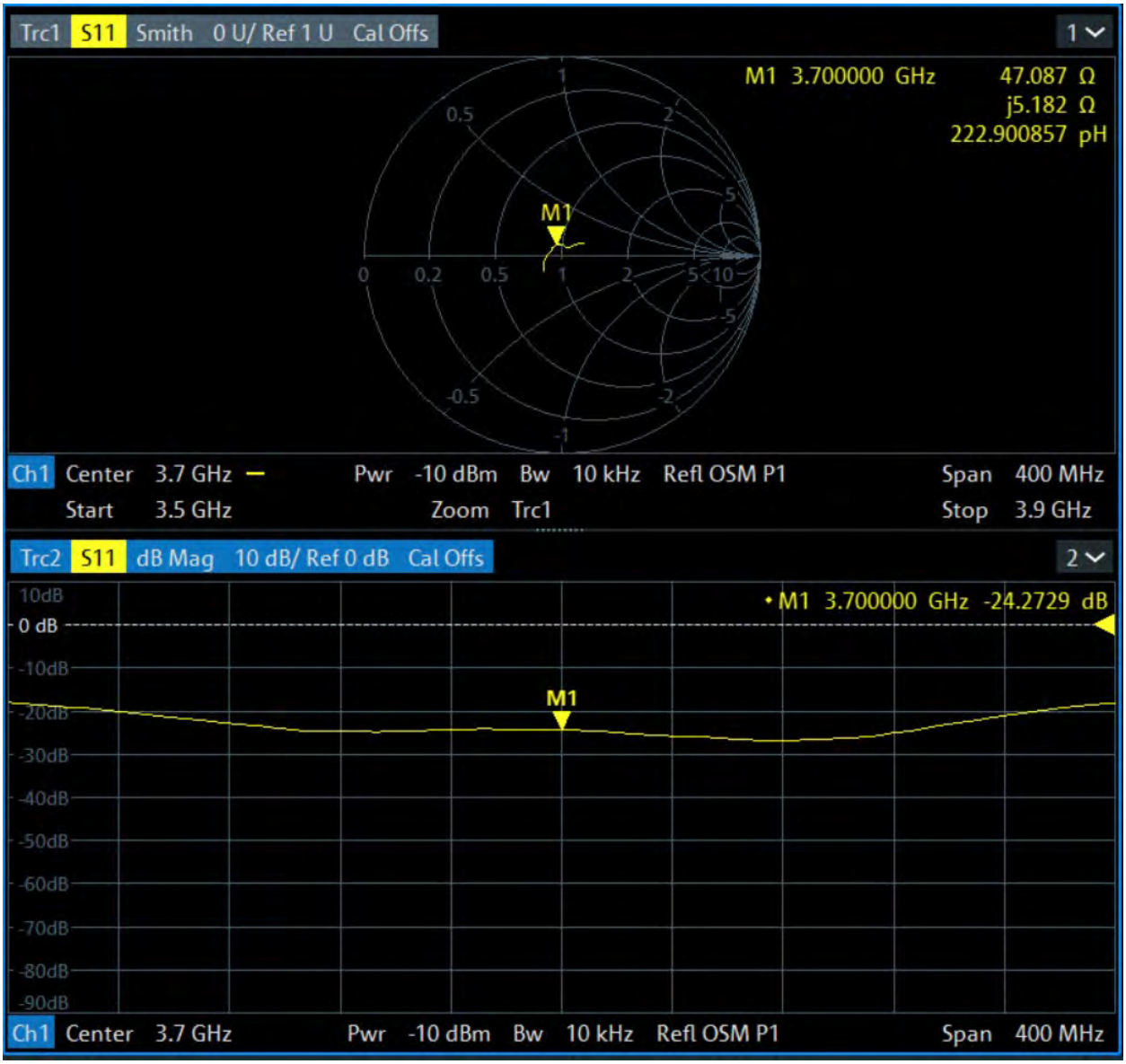
Impedance and Return-Loss Measurement Plot for Head TSL



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IN-HOUSE SAR VERIFICATION SOURCE CALIBRATION EXTENSION

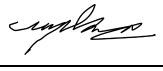
Object	D3700V2 – SN: 1130
Description	SAR Validation Dipole at 3700 MHz
Procedure (s)	Procedure for SAR Verification Source Calibration Extension
In-house Check Date	07/30/2025

Equipment List

Manufacturer	Model	Description	Serial Number	Calibration Date	Calibration Due	CBT
Rohde & Schwarz	ZNL20	Vector Network Analyzer	101202	9/12/2024	9/12/2025	
Rohde & Schwarz	ZN-Z135	Calibration Kit	5000-309192839	10/31/24	10/31/26	
Control Company	4040	Ambient Thermometer	230581657	8/28/2023	8/28/2025	
Control Company	4040	Ambient Thermometer	230581662	8/28/2023	8/28/2025	
Control Company	4352	Long Stem Liquid Thermometer	230662223	9/28/2023	9/28/2025	
Control Company	4352	Long Stem Liquid Thermometer	230662212	9/28/2023	9/28/2025	
Micro-Coax	UFB205A-0-0240-30x30	SMA M-F RF test Cable (DC - 18 GHz)	-			✓
Maury-Micro	360D	10dB RF Fixed Attenuator (DC - 18 GHz) + Short Circuit Termination	7799	12/28/2024	12/28/2025	
Huber+Suhner	SF126	High Performance RF Cable	570292/126			✓
SPEAG	DAE4ip	Data Acquisition Electronics with Integ. Power	1844	11/6/2024	11/6/2025	
SPEAG	DAK-3.5	DAK-3.5 Dielectric Probe	1349	9/2/2024	9/2/2025	
SPEAG	EX3DV4	SAR Measurement Probe	7853	11/7/2024	11/7/2025	
SPEAG	Powersource1	Signal Generator	4341	1/9/2025	1/9/2026	

CBT: Components calibrated before testing. Prior to testing, the measurement paths containing a cable, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator, power sensor, or VNA) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.

Measurement Uncertainty = ±27% (k=2)

	Name	Function	Signature
Tested By:	Yue Li	Engineer	
Approved By:	Phuong Nguyen	Technical Manager	

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Per FCC KDB Publication 865664 D01, dipole can have longer calibration intervals of up to three years when it is demonstrated that the SAR target, impedance and return loss of the dipole have remained stable according to the following requirements:

1. Measured SAR does not deviate from the calibrated SAR value by more than 10%.
2. Return loss does not deviate by more than 20% from the previous measurement (i.e. value in dB x 0.2) and meet the required minimum return-loss.
3. Real and imaginary part of the impedance do not deviate by more than 5 Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have an extended calibration interval:

Dipole SN	Freq (MHz)	In-house Check Date	Cal Date	Head SAR target (1g) @ 30dBm (W/kg)	Measured Head SAR (1g) @ 17dBm (W/kg)	1g SAR Dev (%)	Head SAR target (10g) @ 30dBm (W/kg)	Measured Head SAR (10g) @ 17dBm (W/kg)	10g SAR Dev(%)	Cert Head Impedance (Ohm) - Real	Previous Head Impedance (Ohm) - Real	Measured Head Impedance (Ohm) - Real	Head Impedance Deviation (Ohm) - Real	Cert Head Impedance (Ohm) - Imaginary	Previous Head Impedance (Ohm) - Imaginary	Measured Head Impedance (Ohm) - Imaginary	Head Impedance Deviation (Ohm) - Imaginary	Cert Head Return Loss (dB)	Previous Head Return Loss (dB)	Measured Head Return Loss (dB)	Return Loss Dev (%)	PASS/FAIL
1130	3700	11/7/2024	10/12/2023	66.6	3.11	-6.83%	24.5	1.16	-5.53%	46.0	46.0	47.1	1.1	4.4	4.4	5.2	0.8	-24.2	-24.2	-24.3	-1.60%	PASS
1130	3700	7/30/2025	10/12/2023	66.6	3.22	-3.53%	24.5	1.20	-2.27%	46.0	47.1	47.0	-0.1	4.4	5.2	4.4	-0.8	-24.2	-24.3	-25.2	-19.19%	PASS

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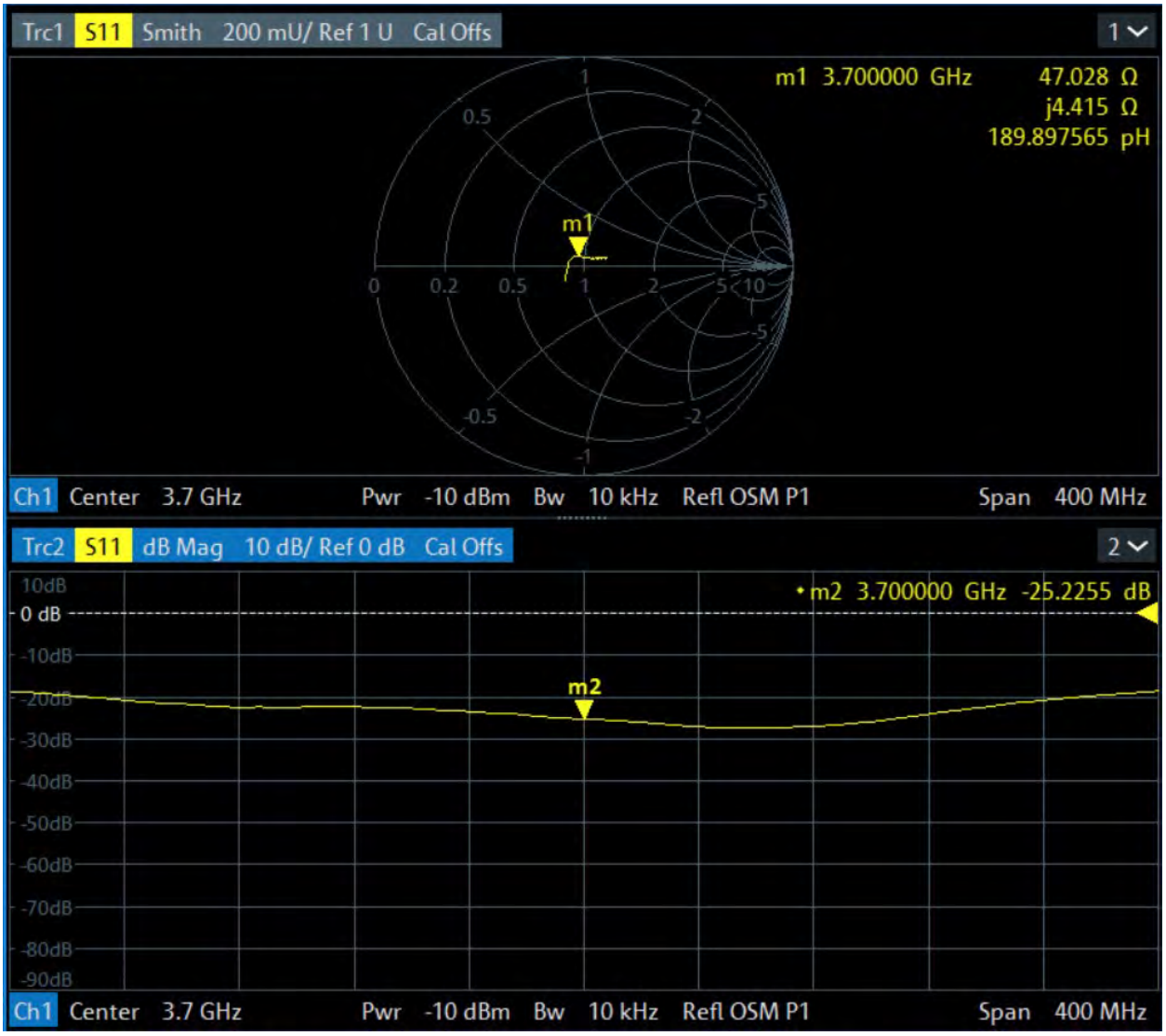
Impedance and Return-Loss Measurement Plot for Head TSL



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S Schweizerischer Kalibrierdienst
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Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client **RF Safety Lab**
Catonsville, USA

Certificate No. **D3500V2-1154_Oct23**

CALIBRATION CERTIFICATE

Object D3500V2 - SN:1154

MAB 11/20/23

Calibration procedure(s) QA CAL-22.v7
Calibration Procedure for SAR Validation Sources between 3-10 GHz

Calibration date: October 02, 2023

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP2	SN: 104778	30-Mar-23 (No. 217-03804/03805)	Mar-24
Power sensor NRP-Z91	SN: 103244	30-Mar-23 (No. 217-03804)	Mar-24
Power sensor NRP-Z91	SN: 103245	30-Mar-23 (No. 217-03805)	Mar-24
Reference 20 dB Attenuator	SN: BH9394 (20k)	30-Mar-23 (No. 217-03809)	Mar-24
Type-N mismatch combination	SN: 310982 / 06327	30-Mar-23 (No. 217-03810)	Mar-24
Reference Probe EX3DV4	SN: 3503	07-Mar-23 (No. EX3-3503_Mar23)	Mar-24
DAE4	SN: 601	19-Dec-22 (No. DAE4-601_Dec22)	Dec-23

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-22)	In house check: Oct-24
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24

	Name	Function	Signature
Calibrated by:	Paulo Pina	Laboratory Technician	
Approved by:	Sven Kühn	Technical Manager	

Issued: October 6, 2023

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

c) DASY System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
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- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
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- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	3500 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	37.9	2.91 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.2 ± 6 %	2.97 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.57 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**65.1 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.47 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.6 W/kg ± 19.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	51.3	3.31 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.5 ± 6 %	3.29 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	6.25 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**62.7 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.37 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.7 W/kg ± 19.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.3 Ω - 3.2 jΩ
Return Loss	- 28.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	54.8 Ω - 0.6 jΩ
Return Loss	- 26.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.132 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

DASY5 Validation Report for Head TSL

Date: 02.10.2023

Test Laboratory: SPEAG, Zurich, Switzerland

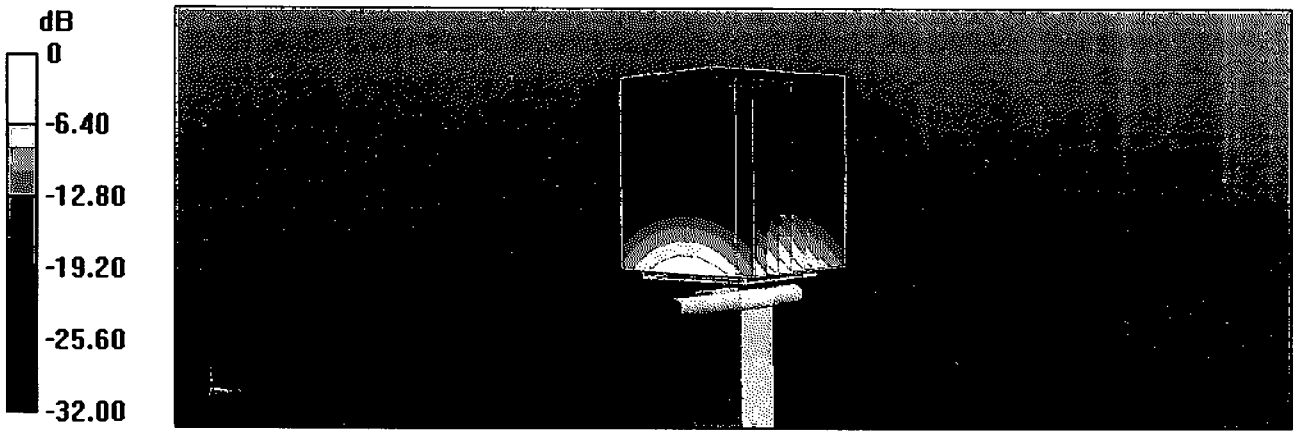
DUT: Dipole 3500 MHz; Type: D3500V2; Serial: D3500V2 - SN:1154

Communication System: UID 0 - CW; Frequency: 3500 MHz
Medium parameters used: f = 3500 MHz; σ = 2.97 S/m; ε_r = 37.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

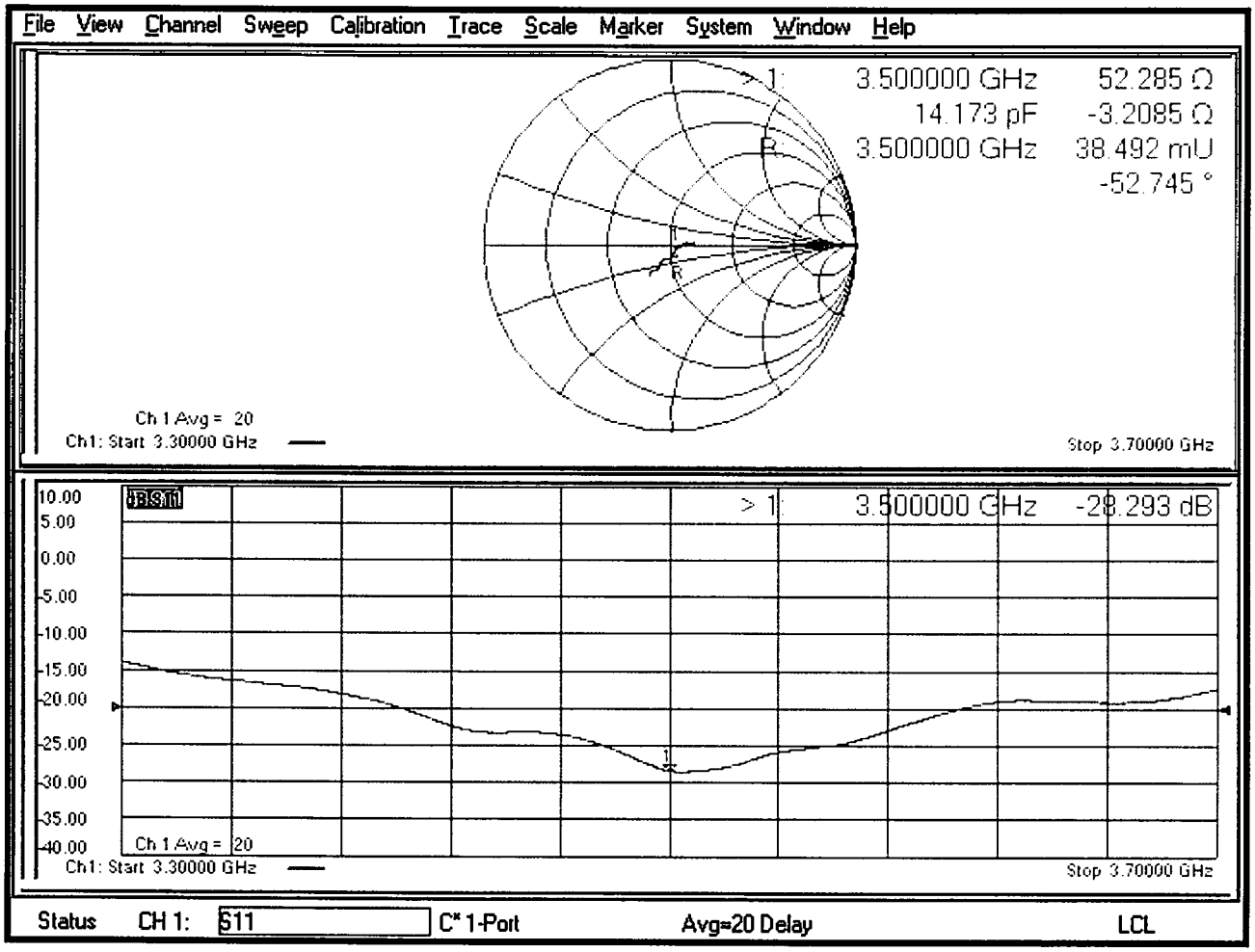
- Probe: EX3DV4 - SN3503; ConvF(7.91, 7.91, 7.91) @ 3500 MHz; Calibrated: 07.03.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 19.12.2022
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Head Tissue/Pin=100 mW, d=10mm, f=3500MHz/Zoom Scan, dist=1.4mm (8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 69.83 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 17.5 W/kg
SAR(1 g) = 6.57 W/kg; SAR(10 g) = 2.47 W/kg
Smallest distance from peaks to all points 3 dB below = 8.2 mm
Ratio of SAR at M2 to SAR at M1 = 74.6%
Maximum value of SAR (measured) = 12.4 W/kg



0 dB = 12.4 W/kg = 10.93 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 02.10.2023

Test Laboratory: SPEAG, Zurich, Switzerland

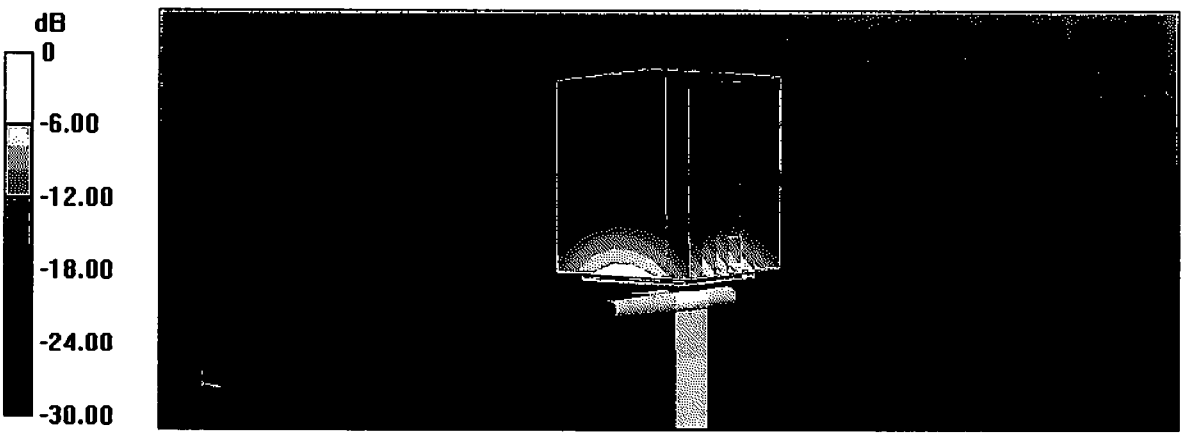
DUT: Dipole 3500 MHz; Type: D3500V2; Serial: D3500V2 - SN:1154

Communication System: UID 0 - CW; Frequency: 3500 MHz
Medium parameters used: f = 3500 MHz; σ = 3.29 S/m; ε_r = 51.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

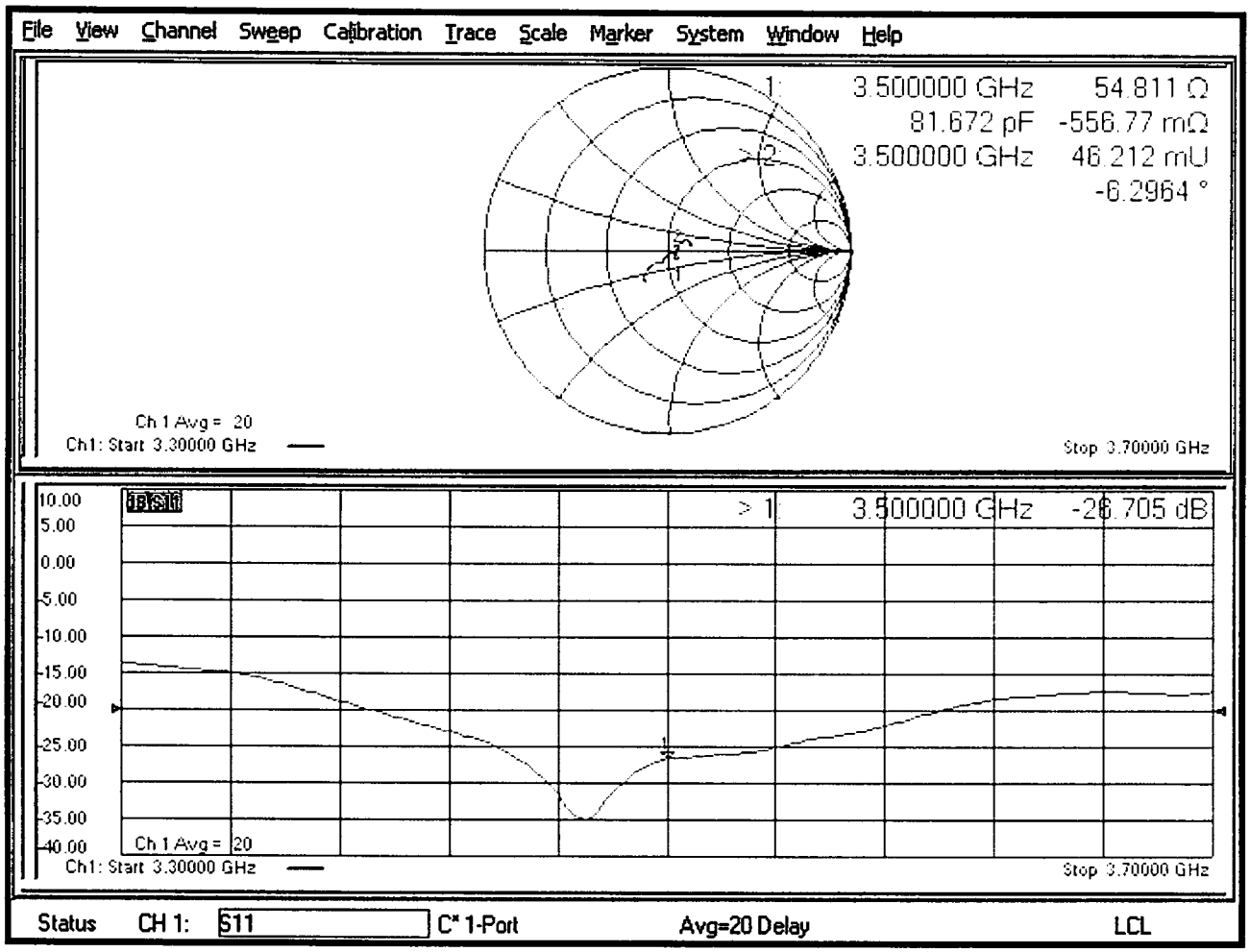
- Probe: EX3DV4 - SN3503; ConvF(7.46, 7.46, 7.46) @ 3500 MHz; Calibrated: 07.03.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 19.12.2022
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Body Tissue/Pin=100 mW, d=10mm, f=3500MHz/Zoom Scan , dist=1.4mm (8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.36 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 16.2 W/kg
SAR(1 g) = 6.25 W/kg; SAR(10 g) = 2.37 W/kg
Smallest distance from peaks to all points 3 dB below = 8 mm
Ratio of SAR at M2 to SAR at M1 = 77.2%
Maximum value of SAR (measured) = 11.4 W/kg



0 dB = 11.4 W/kg = 10.58 dBW/kg

Impedance Measurement Plot for Body TSL



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IN-HOUSE SAR VERIFICATION SOURCE CALIBRATION EXTENSION

Object	D3500V2 – SN: 1154
Description	SAR Validation Dipole at 3500 MHz
Procedure (s)	Procedure for SAR Verification Source Calibration Extension
In-house Check Date	11/7/2024

Equipment List

Manufacturer	Model	Description	Serial Number	Calibration Date	Calibration Due	CBT
Rohde & Schwarz	ZNL20	Vector Network Analyzer	101202	9/12/2024	9/12/2025	
Rohde & Schwarz	ZN-Z135	Calibration Kit	5000-309192839	10/31/24	10/31/26	
Control Company	4040	Ambient Thermometer	230581657	8/28/2023	8/28/2025	
Control Company	4352	Long Stem Liquid Thermometer	230662223	9/28/2023	9/28/2025	
Micro-Coax	UFB205A-0-0240-30x30	SMA M-F RF test Cable (DC - 18 GHz)	-			✓
Mini-Circuits	BW-N20W20+	20dB RF Fixed Attenuator (DC - 18 GHz)	-			✓
Mini-Circuits	NF-SF50+	RF Adapter N Male to SMA Female (DC - 18 GHz)	-			✓
SPEAG	DAE4ip	Data Acquisition Electrionics with Integ. Power	1839	8/14/2024	8/14/2025	
SPEAG	DAK-3.5	DAK-3.5 Dielectric Probe	1349	9/2/2024	9/2/2025	
SPEAG	EX3DV4	SAR Measurement Probe	7836	3/15/2024	3/15/2025	
SPEAG	Powersource1	Signal Generator	4341	1/5/2024	1/5/2025	

CBT: Components calibrated before testing. Prior to testing, the measurement paths containing a cable, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator, power sensor, or VNA) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.

Measurement Uncertainty = ±27% (k=2)

	Name	Function	Signature
Tested By:	Yue Li	Engineer	
Approved By:	Phuong Nguyen	Technical Manager	

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Per FCC KDB Publication 865664 D01, dipole can have longer calibration intervals of up to three years when it is demonstrated that the SAR target, impedance and return loss of the dipole have remained stable according to the following requirements:

1. Measured SAR does not deviate from the calibrated SAR value by more than 10%.
2. Return loss does not deviate by more than 20% from the previous measurement (i.e. value in dB x 0.2) and meet the required minimum return-loss.
3. Real and imaginary part of the impedance do not deviate by more than 5 Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have an extended calibration interval:

Dipole SN	Freq (MHz)	In-house Check Date	Cal Date	Head SAR target (1g) @ 30dBm (W/kg)	Measured Head SAR (1g) @ 17dBm (W/kg)	1g SAR Deviation (%)	Head SAR target (10g) @ 30dBm (W/kg)	Measured Head SAR (10g) @ 17dBm (W/kg)	10g SAR Deviation (%)	Cert Head Impedance (Ohm) - Real	Measured Head Impedance (Ohm) - Real	Head Impedance Deviation (Ohm) - Real	Cert Head Impedance (Ohm) - Imaginary	Measured Head Impedance (Ohm) - Imaginary	Head Impedance Deviation (Ohm) - Imaginary	Cert Head Return Loss (dB)	Measured Head Return Loss (dB)	Return Loss Deviation (%)	PASS/FAIL
1154	3500	11/7/2024	10/2/2023	65.1	3.00	-8.05%	24.6	1.14	-7.54%	52.3	50.6	-1.7	-3.2	-3.8	-0.6	-28.3	-28.4	-2.66%	PASS

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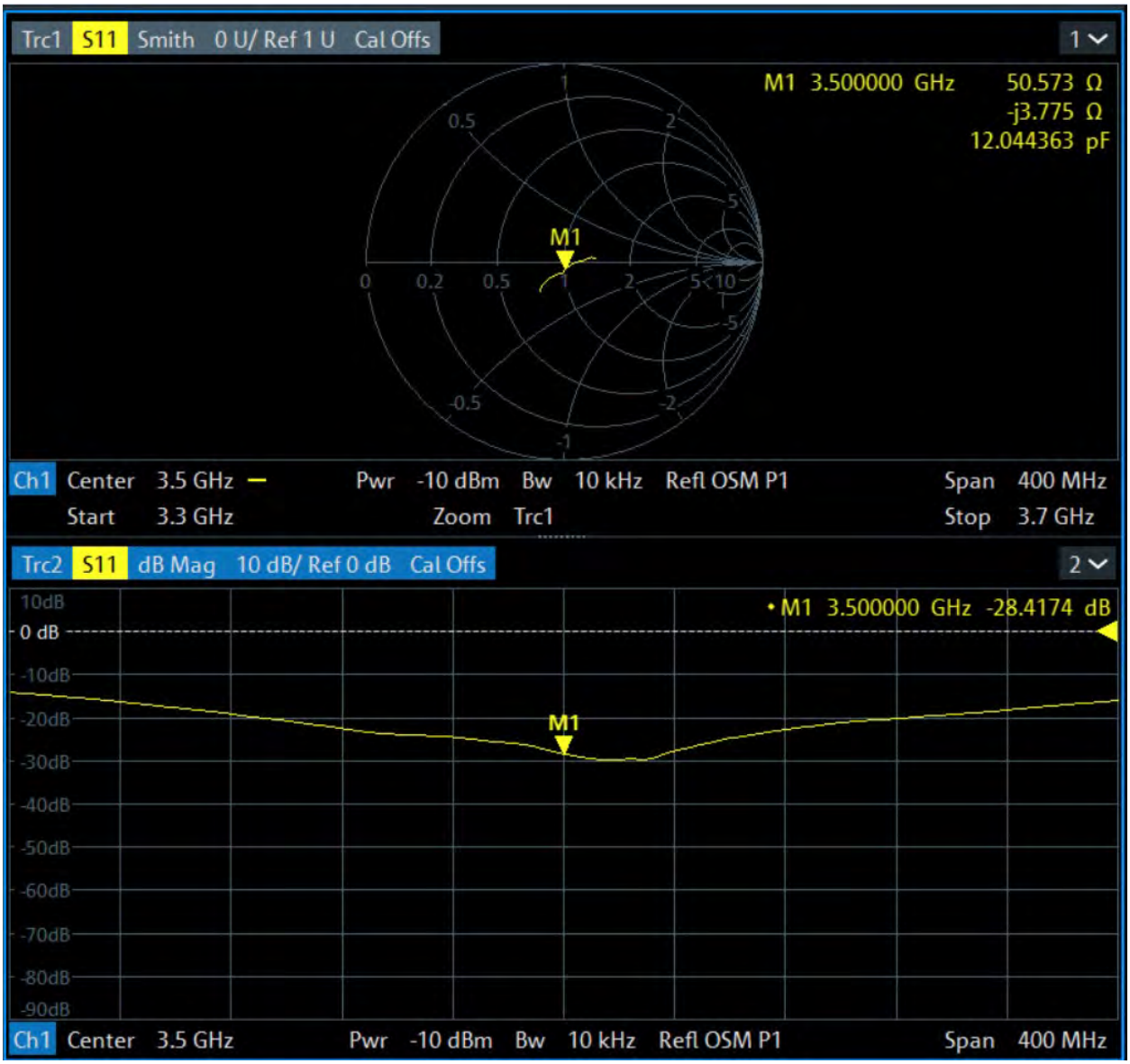
Impedance and Return-Loss Measurement Plot for Head TSL



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IN-HOUSE SAR VERIFICATION SOURCE CALIBRATION EXTENSION

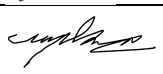
Object	D3500V2 – SN: 1154
Description	SAR Validation Dipole at 3500 MHz
Procedure (s)	Procedure for SAR Verification Source Calibration Extension
In-house Check Date	07/30/2025

Equipment List

Manufacturer	Model	Description	Serial Number	Calibration Date	Calibration Due	CBT
Rohde & Schwarz	ZNL20	Vector Network Analyzer	101202	9/12/2024	9/12/2025	
Rohde & Schwarz	ZN-Z135	Calibration Kit	5000-309192839	10/31/24	10/31/26	
Control Company	4040	Ambient Thermometer	230581657	8/28/2023	8/28/2025	
Control Company	4040	Ambient Thermometer	230581662	8/28/2023	8/28/2025	
Control Company	4352	Long Stem Liquid Thermometer	230662223	9/28/2023	9/28/2025	
Control Company	4352	Long Stem Liquid Thermometer	230662212	9/28/2023	9/28/2025	
Micro-Coax	UFB205A-0-0240-30x30	SMA M-F RF test Cable (DC - 18 GHz)	-			✓
Maury-Micro	360D	10dB RF Fixed Attenuator (DC - 18 GHz) + Short Circuit Termination	7799	12/28/2024	12/28/2025	
Huber+Suhner	SF126	High Performance RF Cable	570292/126			✓
SPEAG	DAE4ip	Data Acquisition Electronics with Integ. Power	1844	11/6/2024	11/6/2025	
SPEAG	DAK-3.5	DAK-3.5 Dielectric Probe	1349	9/2/2024	9/2/2025	
SPEAG	EX3DV4	SAR Measurement Probe	7853	11/7/2024	11/7/2025	
SPEAG	Powersource1	Signal Generator	4341	1/9/2025	1/9/2026	

CBT: Components calibrated before testing. Prior to testing, the measurement paths containing a cable, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator, power sensor, or VNA) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.

Measurement Uncertainty = ±27% (k=2)

	Name	Function	Signature
Tested By:	YL	Engineer	
Approved By:	PN	Technical Manager	

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Per FCC KDB Publication 865664 D01, dipole can have longer calibration intervals of up to three years when it is demonstrated that the SAR target, impedance and return loss of the dipole have remained stable according to the following requirements:

1. Measured SAR does not deviate from the calibrated SAR value by more than 10%.
2. Return loss does not deviate by more than 20% from the previous measurement (i.e. value in dB x 0.2) and meet the required minimum return-loss.
3. Real and imaginary part of the impedance do not deviate by more than 5 Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have an extended calibration interval:

Dipole SN	Freq (MHz)	In-house Check Date	Cal Date	Head SAR target (1g) @ 30dBm (W/kg)	Measured Head SAR (1g) @ 17dBm (W/kg)	1g SAR Dev (%)	Head SAR target (10g) @ 30dBm (W/kg)	Measured Head SAR (10g) @ 17dBm (W/kg)	10g SAR Dev(%)	Cert Head Impedance (Ohm) - Real	Previous Head Impedance (Ohm) - Real	Measured Head Impedance (Ohm) - Real	Head Impedance Deviation (Ohm) - Real	Cert Head Impedance (Ohm) - Imaginary	Previous Head Impedance (Ohm) - Imaginary	Measured Head Impedance (Ohm) - Imaginary	Head Impedance Deviation (Ohm) - Imaginary	Cert Head Return Loss (dB)	Previous Head Return Loss (dB)	Measured Head Return Loss (dB)	Return Loss Dev (%)	PASS/FAIL
1154	3500	11/7/2024	10/2/2023	65.1	3.00	-8.05%	24.6	1.14	-7.54%	52.3	52.3	50.6	-1.7	-3.2	-3.2	-3.8	-0.6	-28.3	-28.3	-28.4	-2.66%	PASS
1154	3500	7/30/2025	10/2/2023	65.1	2.94	-9.89%	24.6	1.13	-8.35%	52.3	50.6	51.5	0.9	-3.2	-3.8	-3.4	0.4	-28.3	-28.4	-28.6	-4.39%	PASS

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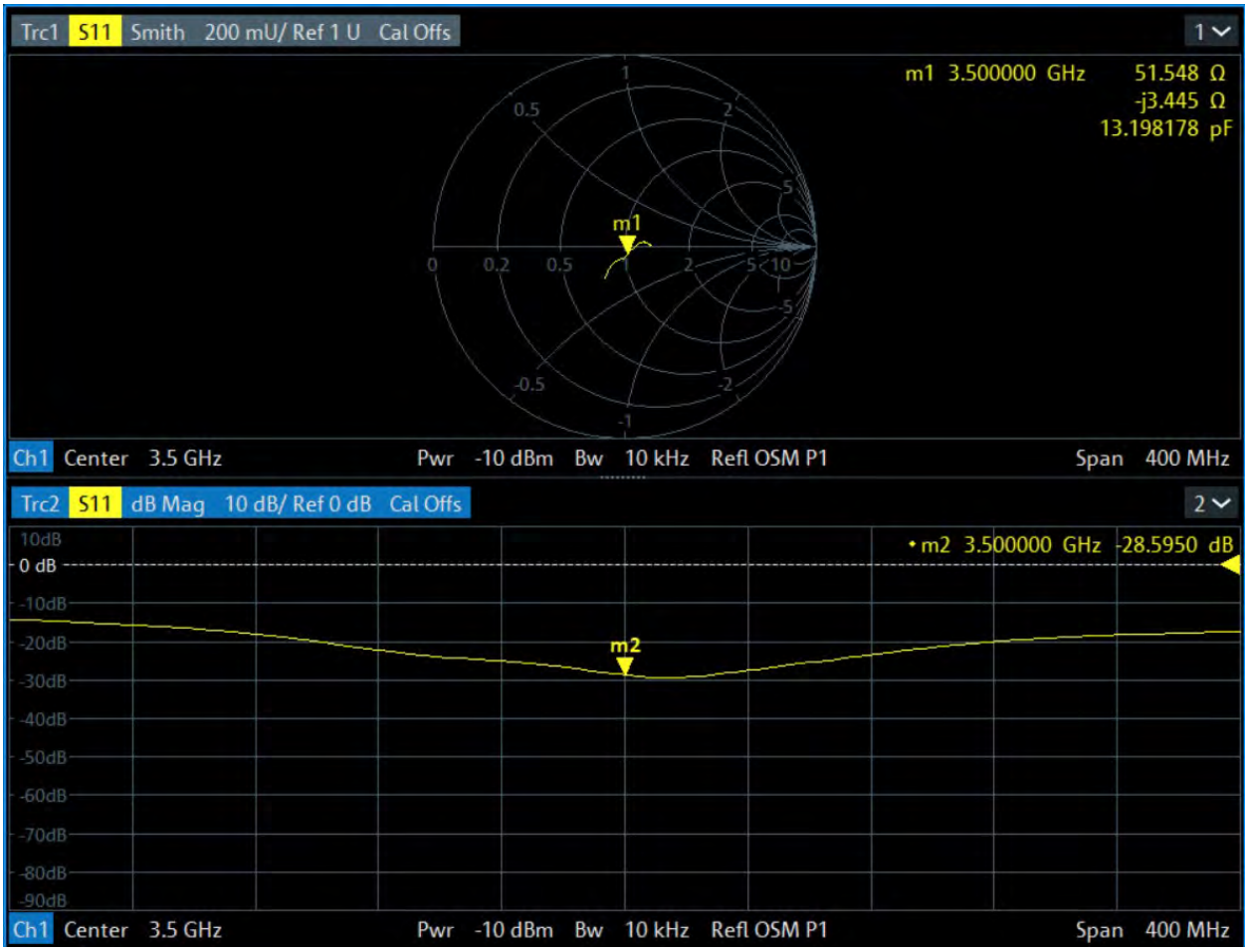
Impedance and Return-Loss Measurement Plot for Head TSL



✓KOK 11/15/2023

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client **RF Safety Lab**
Catonsville, USA

Certificate No. **D1750V2-1205_Oct23**

CALIBRATION CERTIFICATE

Object: D1750V2 - SN:1205

Calibration procedure(s): QA CAL-05.v12
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz

Calibration date: October 11, 2023

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP2	SN: 104778	30-Mar-23 (No. 217-03804/03805)	Mar-24
Power sensor NRP-Z91	SN: 103244	30-Mar-23 (No. 217-03804)	Mar-24
Power sensor NRP-Z91	SN: 103245	30-Mar-23 (No. 217-03805)	Mar-24
Reference 20 dB Attenuator	SN: BH9394 (20k)	30-Mar-23 (No. 217-03809)	Mar-24
Type-N mismatch combination	SN: 310982 / 06327	30-Mar-23 (No. 217-03810)	Mar-24
Reference Probe EX3DV4	SN: 7349	10-Jan-23 (No. EX3-7349_Jan23)	Jan-24
DAE4	SN: 601	03-Oct-23 (No. DAE4-601_Oct23)	Oct-24
DAE4	SN: 900	09-Aug-23 (No. DAE4-900_Aug23)	Aug-24

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-22)	In house check: Oct-24
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24

	Name	Function	Signature
Calibrated by:	Paulo Pina	Laboratory Technician	
Approved by:	Sven Kühn	Technical Manager	

Issued: October 12, 2023

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

c) DASY System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.3 ± 6 %	1.35 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.04 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**36.5 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.77 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**19.2 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.9 ± 6 %	1.46 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.19 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**37.3 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	4.90 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**19.8 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	46.6 Ω + 3.9 jΩ
Return Loss	- 25.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	41.9 Ω + 3.3 jΩ
Return Loss	- 20.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.214 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

Date: 04.10.2023

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1205

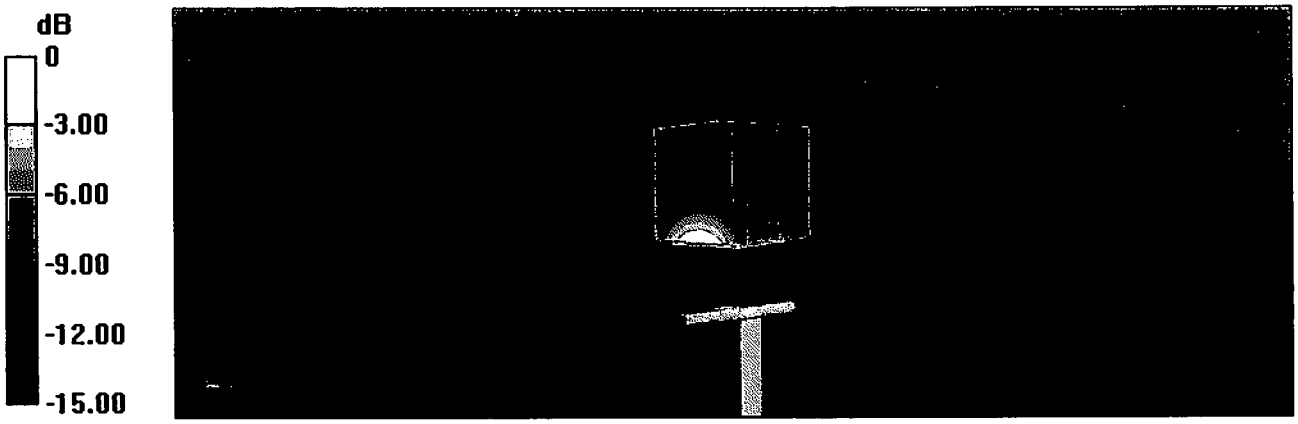
Communication System: UID 0 - CW; Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; σ = 1.35 S/m; ε_r = 40.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.76, 8.76, 8.76) @ 1750 MHz; Calibrated: 10.01.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn900; Calibrated: 09.08.2023
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

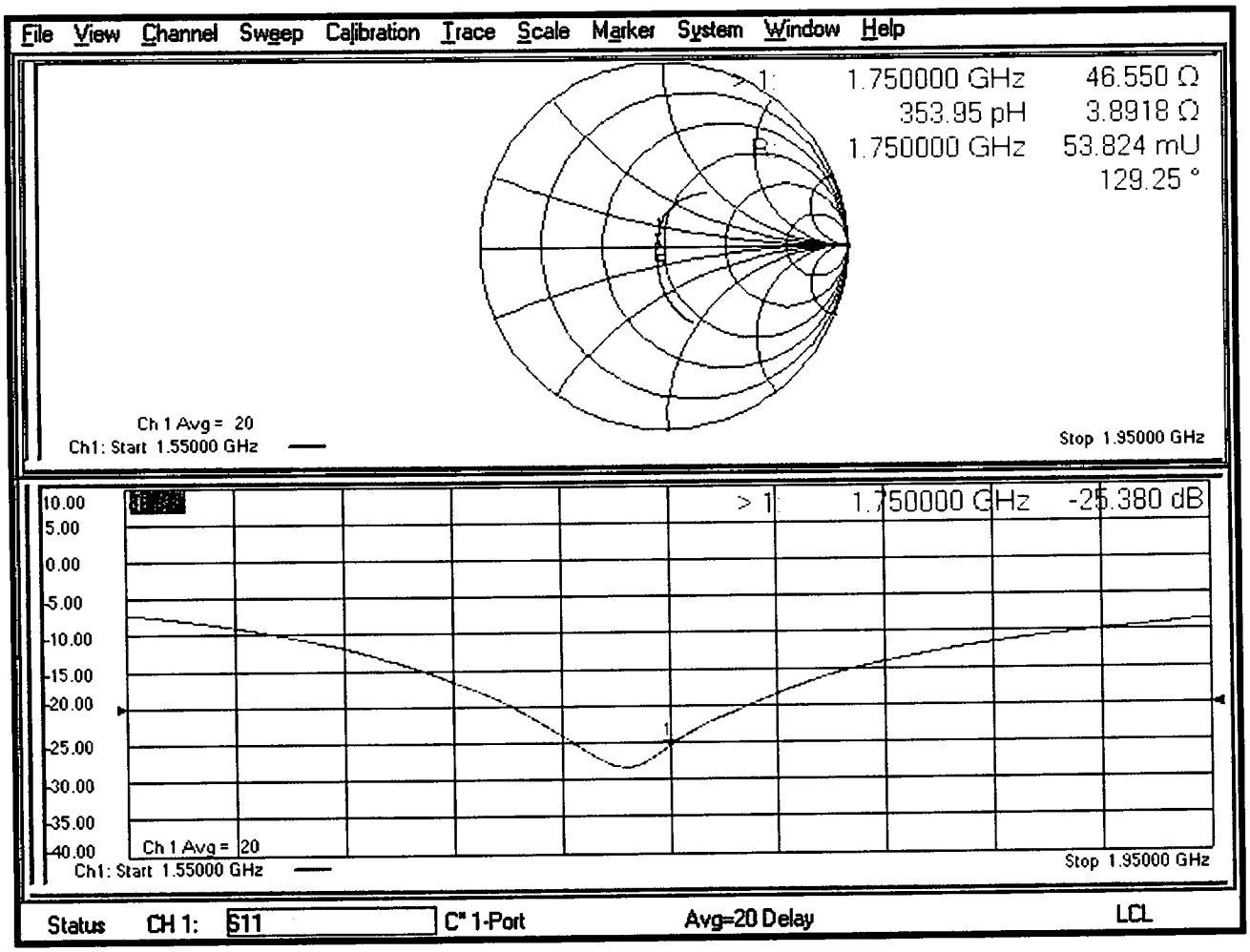
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 106.8 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 16.8 W/kg
SAR(1 g) = 9.04 W/kg; SAR(10 g) = 4.77 W/kg
Smallest distance from peaks to all points 3 dB below = 10 mm
Ratio of SAR at M2 to SAR at M1 = 54.1%
Maximum value of SAR (measured) = 14.0 W/kg



0 dB = 14.0 W/kg = 11.46 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 11.10.2023

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1205

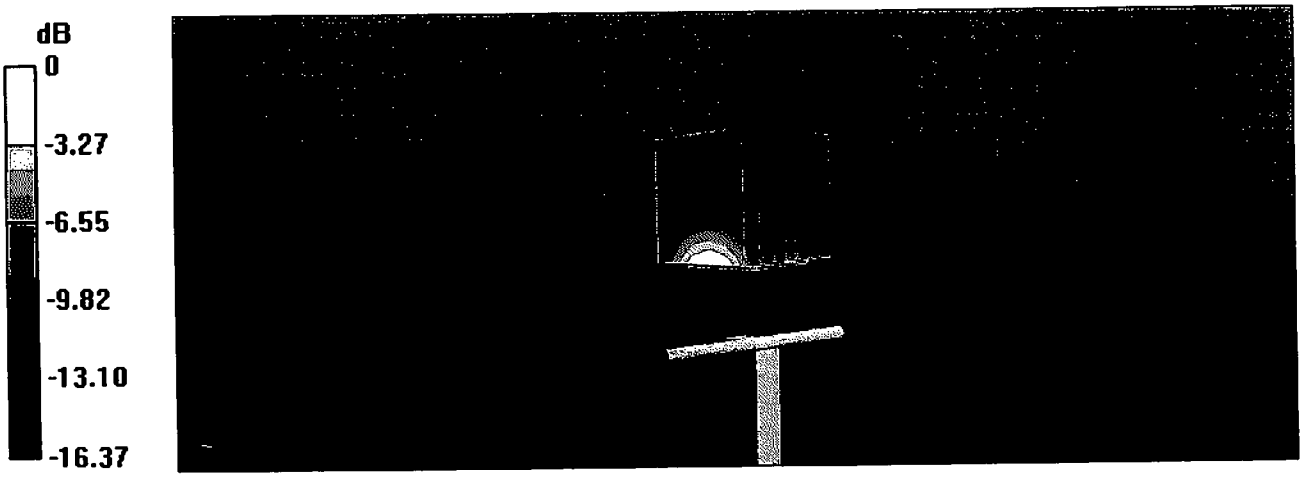
Communication System: UID 0 - CW; Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; σ = 1.46 S/m; ε_r = 53.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.48, 8.48, 8.48) @ 1750 MHz; Calibrated: 10.01.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 03.10.2023
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

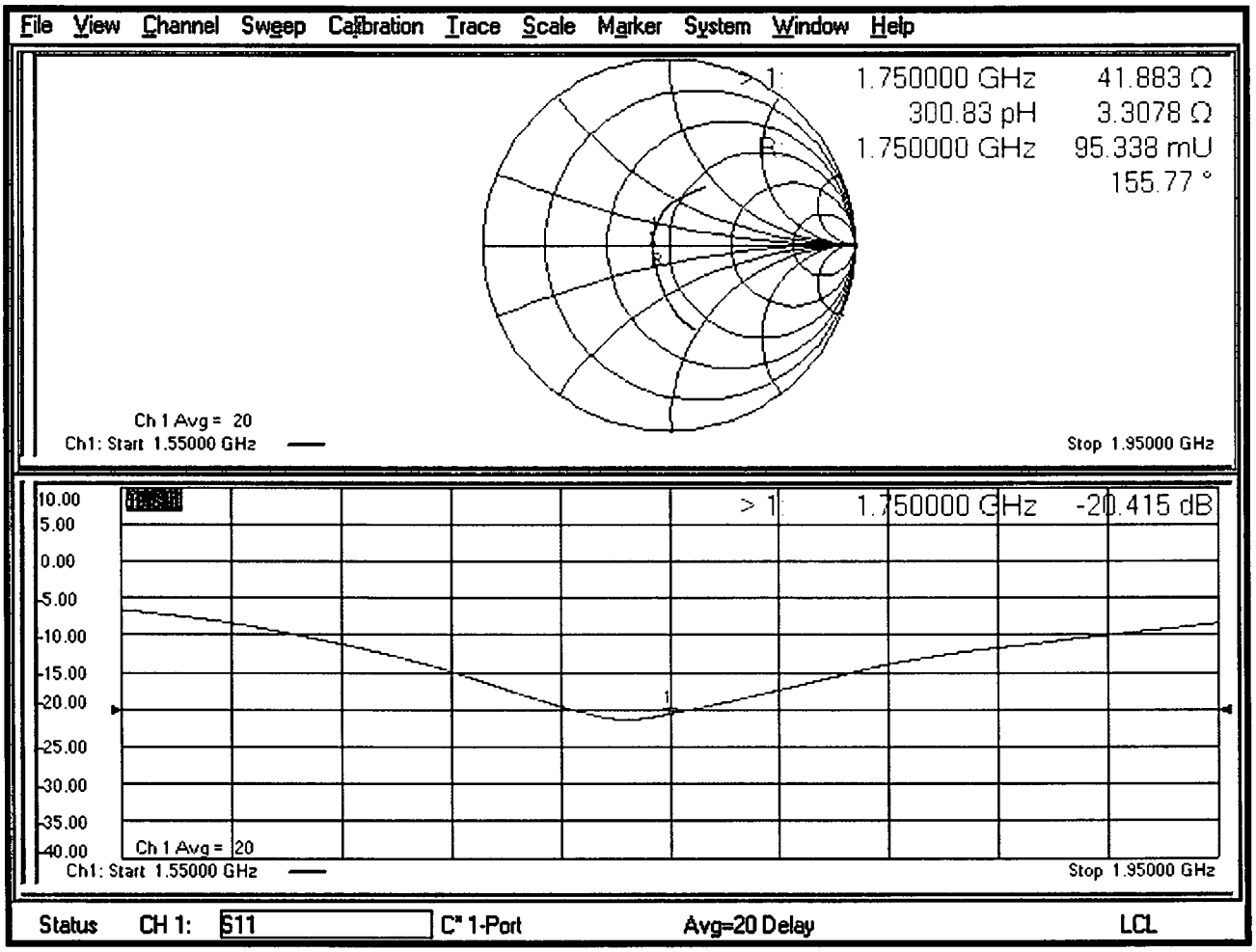
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 103.4 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 16.7 W/kg
SAR(1 g) = 9.19 W/kg; SAR(10 g) = 4.90 W/kg
Smallest distance from peaks to all points 3 dB below = 9.2 mm
Ratio of SAR at M2 to SAR at M1 = 56.1%
Maximum value of SAR (measured) = 14.1 W/kg



0 dB = 14.1 W/kg = 11.50 dBW/kg

Impedance Measurement Plot for Body TSL



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IN-HOUSE SAR VERIFICATION SOURCE CALIBRATION EXTENSION

Object	D1750V2 – SN: 1205
Description	SAR Validation Dipole at 1750 MHz
Procedure (s)	Procedure for SAR Verification Source Calibration Extension
In-house Check Date	11/7/2024

Equipment List

Manufacturer	Model	Description	Serial Number	Calibration Date	Calibration Due	CBT
Rohde & Schwarz	ZNL20	Vector Network Analyzer	101202	9/12/2024	9/12/2025	
Rohde & Schwarz	ZN-Z135	Calibration Kit	5000-309192839	10/31/24	10/31/26	
Control Company	4040	Ambient Thermometer	230581657	8/28/2023	8/28/2025	
Control Company	4352	Long Stem Liquid Thermometer	230662223	9/28/2023	9/28/2025	
Micro-Coax	UFB205A-0-0240-30x30	SMA M-F RF test Cable (DC - 18 GHz)	-			✓
Mini-Circuits	BW-N20W20+	20dB RF Fixed Attenuator (DC - 18 GHz)	-			✓
Mini-Circuits	NF-SF50+	RF Adapter N Male to SMA Female (DC - 18 GHz)	-			✓
SPEAG	DAE4ip	Data Acquisition Electronics with Integ. Power	1839	8/14/2024	8/14/2025	
SPEAG	DAK-3.5	DAK-3.5 Dielectric Probe	1349	9/2/2024	9/2/2025	
SPEAG	EX3DV4	SAR Measurement Probe	7836	3/15/2024	3/15/2025	
SPEAG	Powersource1	Signal Generator	4341	1/5/2024	1/5/2025	

CBT: Components calibrated before testing. Prior to testing, the measurement paths containing a cable, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator, power sensor, or VNA) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.

Measurement Uncertainty = ±27% (k=2)

	Name	Function	Signature
Tested By:	Yue Li	Engineer	
Approved By:	Phuong Nguyen	Technical Manager	

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Per FCC KDB Publication 865664 D01, dipole can have longer calibration intervals of up to three years when it is demonstrated that the SAR target, impedance and return loss of the dipole have remained stable according to the following requirements:

1. Measured SAR does not deviate from the calibrated SAR value by more than 10%.
2. Return loss does not deviate by more than 20% from the previous measurement (i.e. value in dB x 0.2) and meet the required minimum return-loss.
3. Real and imaginary part of the impedance do not deviate by more than 5 Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have an extended calibration interval:

Dipole SN	Freq (MHz)	In-house Check Date	Cal Date	Head SAR target (1g) @ 30dBm (W/kg)	Measured Head SAR (1g) @ 17dBm (W/kg)	1g SAR Deviation (%)	Head SAR target (10g) @ 30dBm (W/kg)	Measured Head SAR (10g) @ 17dBm (W/kg)	10g SAR Deviation (%)	Cert Head Impedance (Ohm) - Real	Measured Head Impedance (Ohm) - Real	Head Impedance Deviation (Ohm) - Real	Cert Head Impedance (Ohm) - Imaginary	Measured Head Impedance (Ohm) - Imaginary	Head Impedance Deviation (Ohm) - Imaginary	Cert Head Return Loss (dB)	Measured Head Return Loss (dB)	Return Loss Deviation (%)	PASS/FAIL
1205	1750	11/7/2024	10/11/2023	36.5	1.80	-1.60%	19.2	0.96	0.07%	46.6	46.9	0.3	3.9	4.3	0.4	-25.4	-25.2	5.68%	PASS

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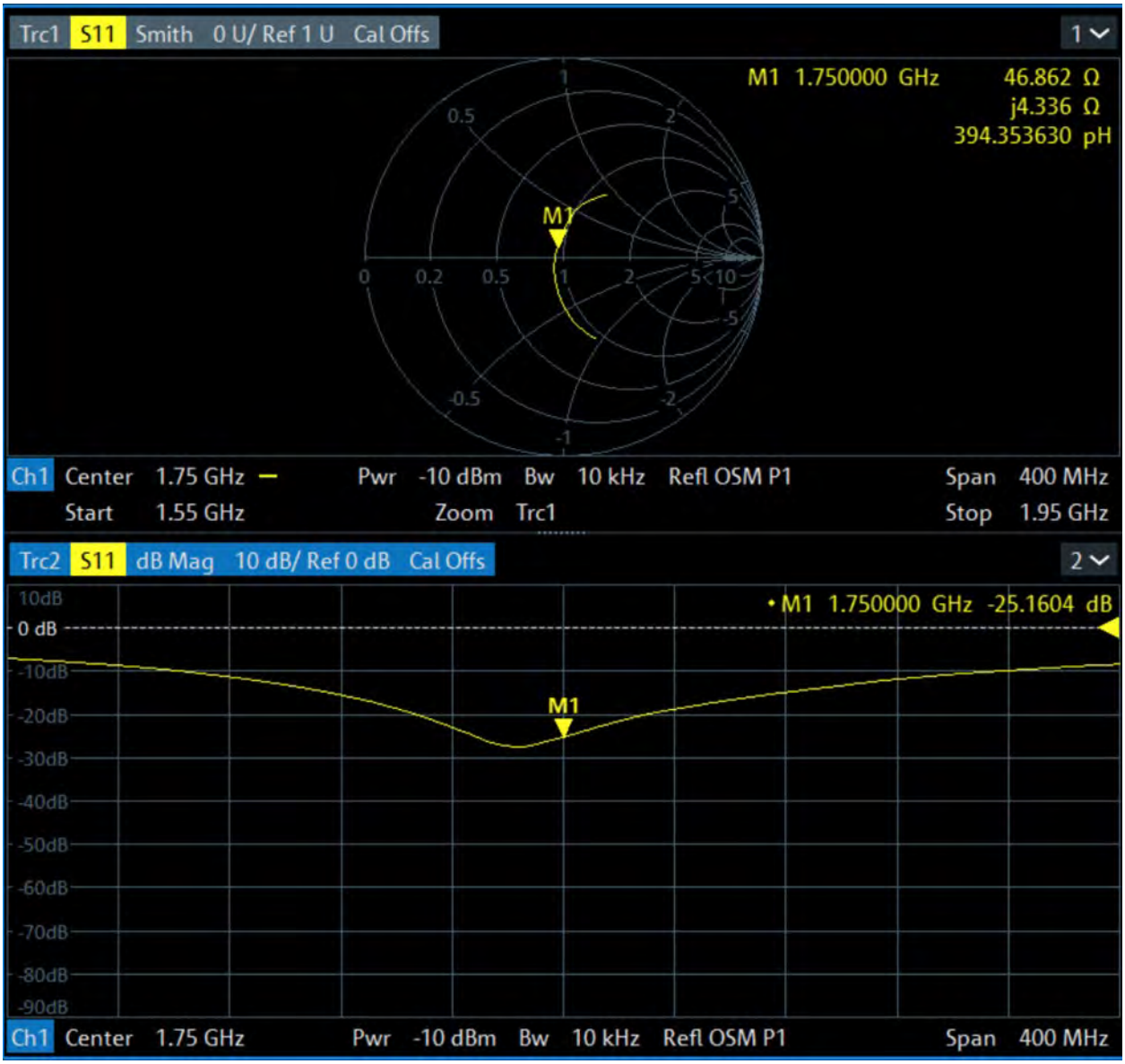
Impedance and Return-Loss Measurement Plot for Head TSL



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IN-HOUSE SAR VERIFICATION SOURCE CALIBRATION EXTENSION

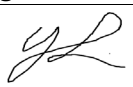
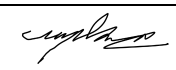
Object	D1750V2 – SN: 1205
Description	SAR Validation Dipole at 1750 MHz
Procedure (s)	Procedure for SAR Verification Source Calibration Extension
In-house Check Date	7/30/2025

Equipment List

Manufacturer	Model	Description	Serial Number	Calibration Date	Calibration Due	CBT
Rohde & Schwarz	ZNL20	Vector Network Analyzer	101202	9/12/2024	9/12/2025	
Rohde & Schwarz	ZN-Z135	Calibration Kit	5000-309192839	10/31/24	10/31/26	
Control Company	4040	Ambient Thermometer	230581657	8/28/2023	8/28/2025	
Control Company	4040	Ambient Thermometer	230581662	8/28/2023	8/28/2025	
Control Company	4352	Long Stem Liquid Thermometer	230662223	9/28/2023	9/28/2025	
Control Company	4352	Long Stem Liquid Thermometer	230662212	9/28/2023	9/28/2025	
Micro-Coax	UFB205A-0-0240-30x30	SMA M-F RF test Cable (DC - 18 GHz)	-			✓
Maury-Micro	360D	10dB RF Fixed Attenuator (DC - 18 GHz) + Short Circuit Termination	7799	12/28/2024	12/28/2025	
Huber+Suhner	SF126	High Performance RF Cable	570292/126			✓
SPEAG	DAE4ip	Data Acquisition Electronics with Integ. Power	1839	9/4/2024	9/4/2025	
SPEAG	DAK-3.5	DAK-3.5 Dielectric Probe	1349	9/2/2024	9/2/2025	
SPEAG	EX3DV4	SAR Measurement Probe	7836	9/12/2024	9/12/2025	
SPEAG	Powersource1	Signal Generator	4341	1/9/2025	1/9/2026	

CBT: Components calibrated before testing. Prior to testing, the measurement paths containing a cable, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator, power sensor, or VNA) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.

Measurement Uncertainty = ±27% (k=2)

	Name	Function	Signature
Tested By:	Yue Li	Engineer	
Approved By:	Phuong Nguyen	Technical Manager	

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Per FCC KDB Publication 865664 D01, dipole can have longer calibration intervals of up to three years when it is demonstrated that the SAR target, impedance and return loss of the dipole have remained stable according to the following requirements:

1. Measured SAR does not deviate from the calibrated SAR value by more than 10%.
2. Return loss does not deviate by more than 20% from the previous measurement (i.e. value in dB x 0.2) and meet the required minimum return-loss.
3. Real and imaginary part of the impedance do not deviate by more than 5 Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have an extended calibration interval:

Dipole SN	Freq (MHz)	In-house Check Date	Cal Date	Head SAR target (1g) @ 30dBm (W/kg)	Measured Head SAR (1g) @ 17dBm (W/kg)	1g SAR Dev (%)	Head SAR target (10g) @ 30dBm (W/kg)	Measured Head SAR (10g) @ 17dBm (W/kg)	10g SAR Dev(%)	Cert Head Impedance (Ohm) - Real	Previous Head Impedance (Ohm) - Real	Measured Head Impedance (Ohm) - Real	Head Impedance Deviation (Ohm) - Real	Cert Head Impedance (Ohm) - Imaginary	Previous Head Impedance (Ohm) - Imaginary	Measured Head Impedance (Ohm) - Imaginary	Head Impedance Deviation (Ohm) - Imaginary	Cert Head Return Loss (dB)	Previous Head Return Loss (dB)	Measured Head Return Loss (dB)	Return Loss Dev (%)	PASS/FAIL
1205	1750	11/7/2024	10/11/2023	36.5	1.80	-1.60%	19.2	0.96	0.07%	46.6	46.6	46.9	0.3	3.9	3.9	4.3	0.4	-25.4	-25.4	-25.2	5.68%	PASS
1205	1750	7/30/2025	10/11/2023	36.5	1.83	0.04%	19.2	0.98	2.05%	46.6	46.9	47.0	0.1	3.9	4.3	3.9	-0.4	-25.4	-25.2	-25.9	-15.04%	PASS

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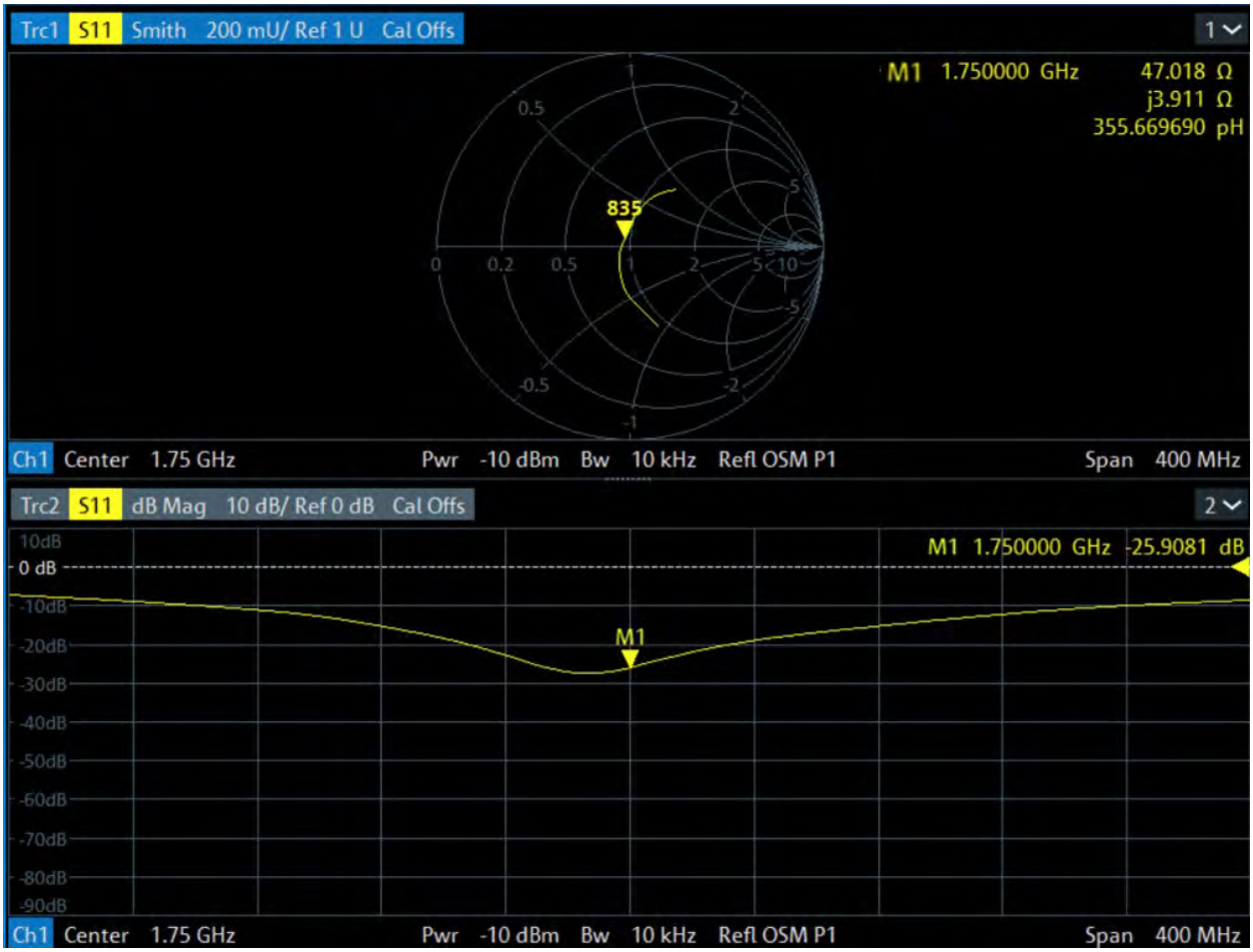
Impedance and Return-Loss Measurement Plot for Head TSL



Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client **RF Safety Lab**
Catonsville, USA

Certificate No. **D2600V2-1215_Nov24**

CALIBRATION CERTIFICATE

MAB 11/21/24

Object	D2600V2 - SN: 1215
Calibration procedure(s)	QA CAL-05.v12 Calibration Procedure for SAR Validation Sources between 0.7 - 3 GHz
Calibration date	November 15, 2024

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Cal
Power Sensor R&S NRP-33T	SN: 100967	28-Mar-24 (No. 217-04038)	Mar-25
Power Sensor R&S NRP18A	SN: 101859	22-Jul-24 (No. 4030A315008547)	Jul-25
Spectrum Analyzer R&S FSV40	SN: 101832	25-Jan-24 (No. 4030-315007551)	Jan-25
Mismatch; Short [S4188] Attenuator [S4423]	SN: 1152	28-Mar-24 (No. 217-04050)	Mar-25
OCP DAK-12	SN: 1016	24-Sep-24 (No. OCP-DAK12-1016_Sep24)	Sep-25
OCP DAK-3.5	SN: 1249	23-Sep-24 (No. OCP-DAK3.5-1249_Sep24)	Sep-25
Reference Probe EX3DV4	SN: 7349	03-Jun-24 (No. EX3-7349_Jun24)	Jun-25
DAE4ip	SN: 1836	28-Oct-24 (No. DAE4ip-1836_Oct24)	Oct-25

Secondary Standards	ID	Check Date (in house)	Scheduled Check
ACAD Source Box	SN: 1000	28-May-24 (No. 675-ACAD_Source_Box-240528)	May-25
Signal Generator R&S SMB100A	SN: 182081	28-May-24 (No. 675-CAL16-S4588-240528)	May-25
Mismatch; SMA	SN: 1102	22-May-24 (No. 675-Mismatch_SMA-240522)	May-25

	Name	Function	Signature
Calibrated by	Paulo Pina	Laboratory Technician	
Approved by	Sven Kühn	Technical Manager	

Issued: November 15, 2024

Glossary

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards

- IEC/IEEE 62209-1528,"Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation

- DASY System Handbook

Methods Applied and Interpretation of Parameters

- *Measurement Conditions*: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL*: The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss*: These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay*: One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured*: SAR measured at the stated antenna input power.
- *SAR normalized*: SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters*: The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY8 Module SAR	16.4.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with spacer
Zoom Scan Resolution	dx, dy = 5mm, dz = 1.5mm	Graded Ratio = 1.5 mm (Z direction)
Frequency	2600MHz ±1MHz	

Head TSL parameters at 2600 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m
Measured Head TSL parameters	(22.0 ±0.2)°C	37.2 ±6%	1.99 mho/m ±6%
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL at 2600 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	24 dBm input power	13.9 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	55.3 W/kg ±17.0% (k = 2)

SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	24 dBm input power	6.25 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.9 W/kg ±16.5% (k = 2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 2600 MHz

Impedance	46.9 Ω + 0.1 jΩ
Return Loss	-29.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.142 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard. No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

System Performance Check Report

Summary

Dipole	Frequency [MHz]	TSL	Power [dBm]
D2600V2 - SN1215	2600	HSL	24

Exposure Conditions

Phantom Section, TSL	Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor	TSL Conductivity [S/m]	TSL Permittivity
Flat	10		CW, 0--	2600, 0	7.3	1.99	37.2

Hardware Setup

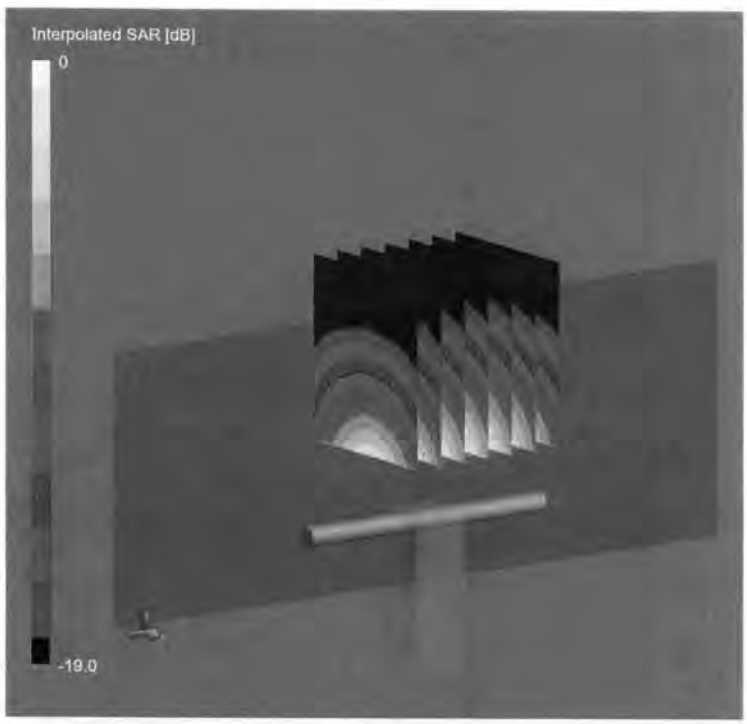
Phantom	TSL, Measured Date	Probe, Calibration Date	DAE, Calibration Date
MFP V8.0 Center	HSL, 2024-11-15	EX3DV4 - SN7349, 2024-06-03	DAE4ip Sn1836, 2024-10-28

Scans Setup

	Zoom Scan
Grid Extents [mm]	30 x 30 x 30
Grid Steps [mm]	5.0 x 5.0 x 1.5
Sensor Surface [mm]	1.4
Graded Grid	Yes
Grading Ratio	1.5
MAIA	N/A
Surface Detection	VMS + 6p
Scan Method	Measured

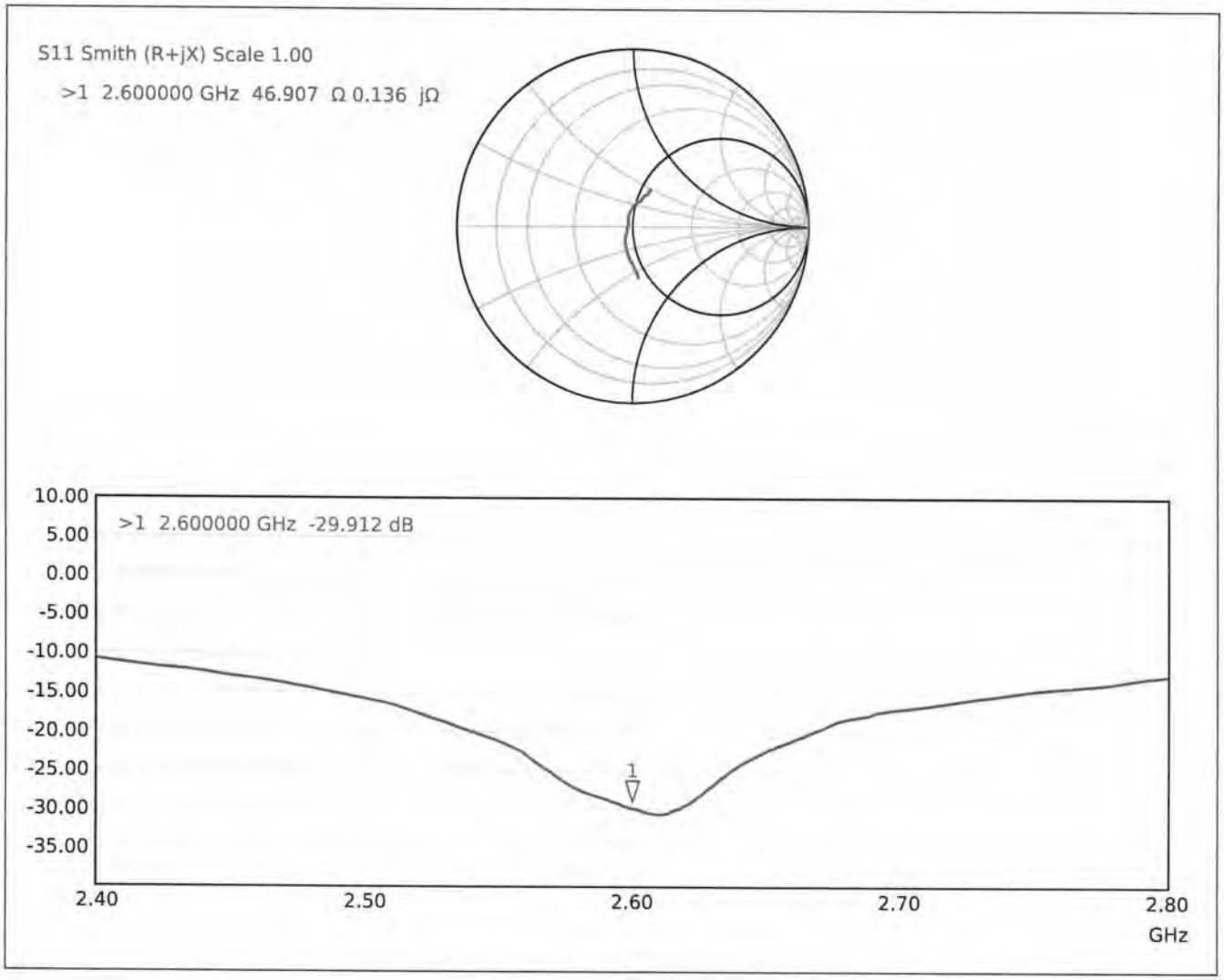
Measurement Results

	Zoom Scan
Date	2024-11-15
psSAR1g [W/Kg]	13.9
psSAR10g [W/Kg]	6.25
Power Drift [dB]	0.01
Power Scaling	Disabled
Scaling Factor [dB]	
TSL Correction	Positive / Negative



0 dB = 29.9 W/Kg

Impedance Measurement Plot for Head TSL



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IN-HOUSE SAR VERIFICATION SOURCE CALIBRATION EXTENSION

Object	D2600V2 – SN: 1215
Description	SAR Validation Dipole at 2600 MHz
Procedure (s)	Procedure for SAR Verification Source Calibration Extension
In-house Check Date	07/29/2025

Equipment List

Manufacturer	Model	Description	Serial Number	Calibration Date	Calibration Due	CBT
Rohde & Schwarz	ZNL20	Vector Network Analyzer	101202	9/12/2024	9/12/2025	
Rohde & Schwarz	ZN-Z135	Calibration Kit	5000-309192839	10/31/24	10/31/26	
Control Company	4040	Ambient Thermometer	230581657	8/28/2023	8/28/2025	
Control Company	4040	Ambient Thermometer	230581662	8/28/2023	8/28/2025	
Control Company	4352	Long Stem Liquid Thermometer	230662223	9/28/2023	9/28/2025	
Control Company	4352	Long Stem Liquid Thermometer	230662212	9/28/2023	9/28/2025	
Micro-Coax	UFB205A-0-0240-30x30	SMA M-F RF test Cable (DC - 18 GHz)	-			✓
Maury-Micro	360D	10dB RF Fixed Attenuator (DC - 18 GHz) + Short Circuit Termination	7799	12/28/2024	12/28/2025	
Huber+Suhner	SF126	High Performance RF Cable	570292/126			✓
SPEAG	DAE4ip	Data Acquisition Electronics with Integ. Power	1839	9/4/2024	9/4/2025	
SPEAG	DAK-3.5	DAK-3.5 Dielectric Probe	1349	9/2/2024	9/2/2025	
SPEAG	EX3DV4	SAR Measurement Probe	7836	9/12/2024	9/12/2025	
SPEAG	Powersource1	Signal Generator	4341	1/9/2025	1/9/2026	

CBT: Components calibrated before testing. Prior to testing, the measurement paths containing a cable, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator, power sensor, or VNA) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.

Measurement Uncertainty = ±27% (k=2)

	Name	Function	Signature
Tested By:	Yue Li	Engineer	
Approved By:	Phuong Nguyen	Technical Manager	

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1. Measured SAR does not deviate from the calibrated SAR value by more than 10%.
2. Return loss does not deviate by more than 20% from the previous measurement (i.e. value in dB x 0.2) and meet the required minimum return-loss.
3. Real and imaginary part of the impedance do not deviate by more than 5 Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have an extended calibration interval:

Dipole SN	Freq (MHz)	In-house Check Date	Cal Date	Head SAR target (1g) @ 20dBm (W/kg)	Measured Head SAR (1g) @ 17dBm (W/kg)	1g SAR Dev (%)	Head SAR target (10g) @ 20dBm (W/kg)	Measured Head SAR (10g) @ 17dBm (W/kg)	10g SAR Dev(%)	Cert Head Impedance (Ohm) - Real	Previous Head Impedance (Ohm) - Real	Measured Head Impedance (Ohm) - Real	Head Impedance Deviation (Ohm) - Real	Cert Head Impedance (Ohm) - Imaginary	Previous Head Impedance (Ohm) - Imaginary	Measured Head Impedance (Ohm) - Imaginary	Head Impedance Deviation (Ohm) - Imaginary	Cert Head Return Loss (dB)	Previous Head Return Loss (dB)	Measured Head Return Loss (dB)	Return Loss Dev (%)	PASS/FAIL	Note
1215	2600	12/31/2024	11/15/2024							46.9	46.9	47.1	0.1	0.1	0.1	1.3	1.2	-29.9	-29.9	-29.9	+0.00%	PASS	In-house check after Calibration
1215	2600	7/29/2025	11/15/2024	55.4	23.9	-56.86%	54.9	23.7	-56.83%	46.9	47.1	47.1	0.2	0.1	1.3	1.3	0.0	-29.9	-29.9	-29.9	0.00%	PASS	

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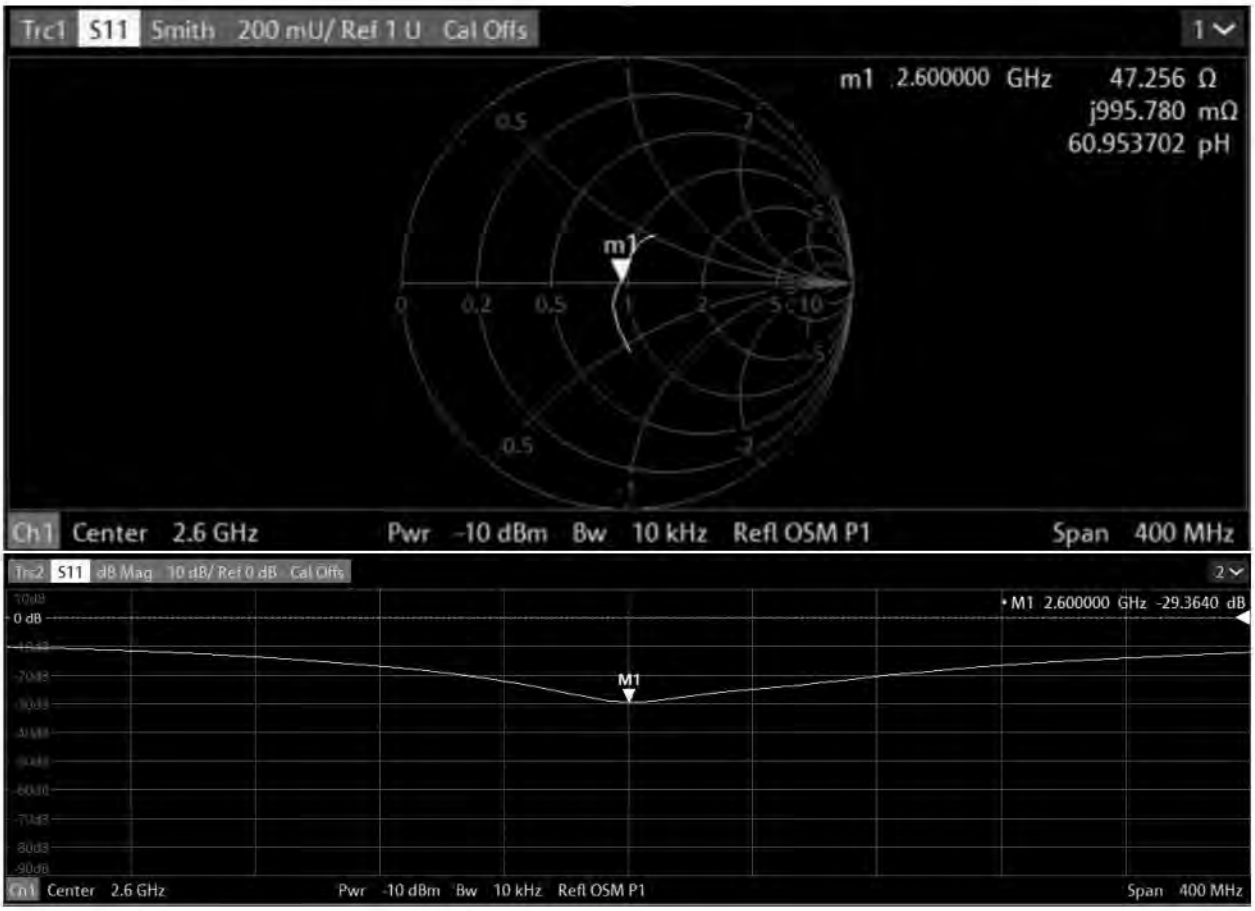
Impedance and Return-Loss Measurement Plot for Head TSL



✓ KOK 11/10/23

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client **RF Safety Lab**
Catonsville, USA

Certificate No. **D750V3-1235_Oct23**

CALIBRATION CERTIFICATE

Object D750V3 - SN:1235

Calibration procedure(s) QA CAL-05.v12
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz

Calibration date: October 11, 2023

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP2	SN: 104778	30-Mar-23 (No. 217-03804/03805)	Mar-24
Power sensor NRP-Z91	SN: 103244	30-Mar-23 (No. 217-03804)	Mar-24
Power sensor NRP-Z91	SN: 103245	30-Mar-23 (No. 217-03805)	Mar-24
Reference 20 dB Attenuator	SN: BH9394 (20k)	30-Mar-23 (No. 217-03809)	Mar-24
Type-N mismatch combination	SN: 310982 / 06327	30-Mar-23 (No. 217-03810)	Mar-24
Reference Probe EX3DV4	SN: 7349	10-Jan-23 (No. EX3-7349_Jan23)	Jan-24
DAE4	SN: 601	03-Oct-23 (No. DAE4-601_Oct23)	Oct-24

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-22)	In house check: Oct-24
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24

	Name	Function	Signature
Calibrated by:	Paulo Pina	Laboratory Technician	
Approved by:	Sven Kühn	Technical Manager	

Issued: October 12, 2023

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

c) DASY System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.2 ± 6 %	0.89 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**8.69 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.42 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**5.69 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.5 ± 6 %	0.95 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.16 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**8.72 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.42 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**5.73 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.3 Ω - 1.0 jΩ
Return Loss	- 27.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.1 Ω - 3.3 jΩ
Return Loss	- 29.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.043 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

DASY5 Validation Report for Head TSL

Date: 11.10.2023

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1235

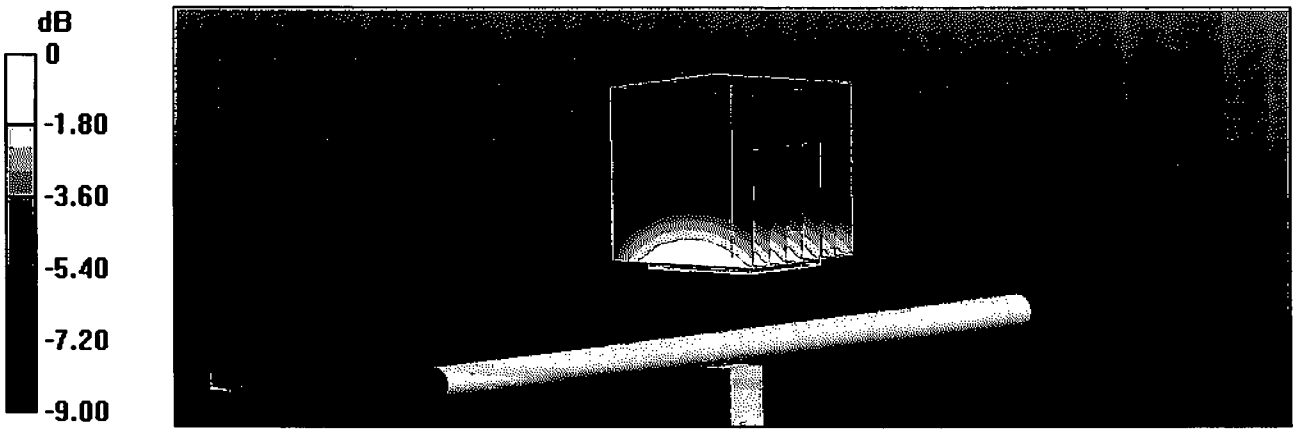
Communication System: UID 0 - CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; σ = 0.89 S/m; ε_r = 42.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.11, 10.11, 10.11) @ 750 MHz; Calibrated: 10.01.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 03.10.2023
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

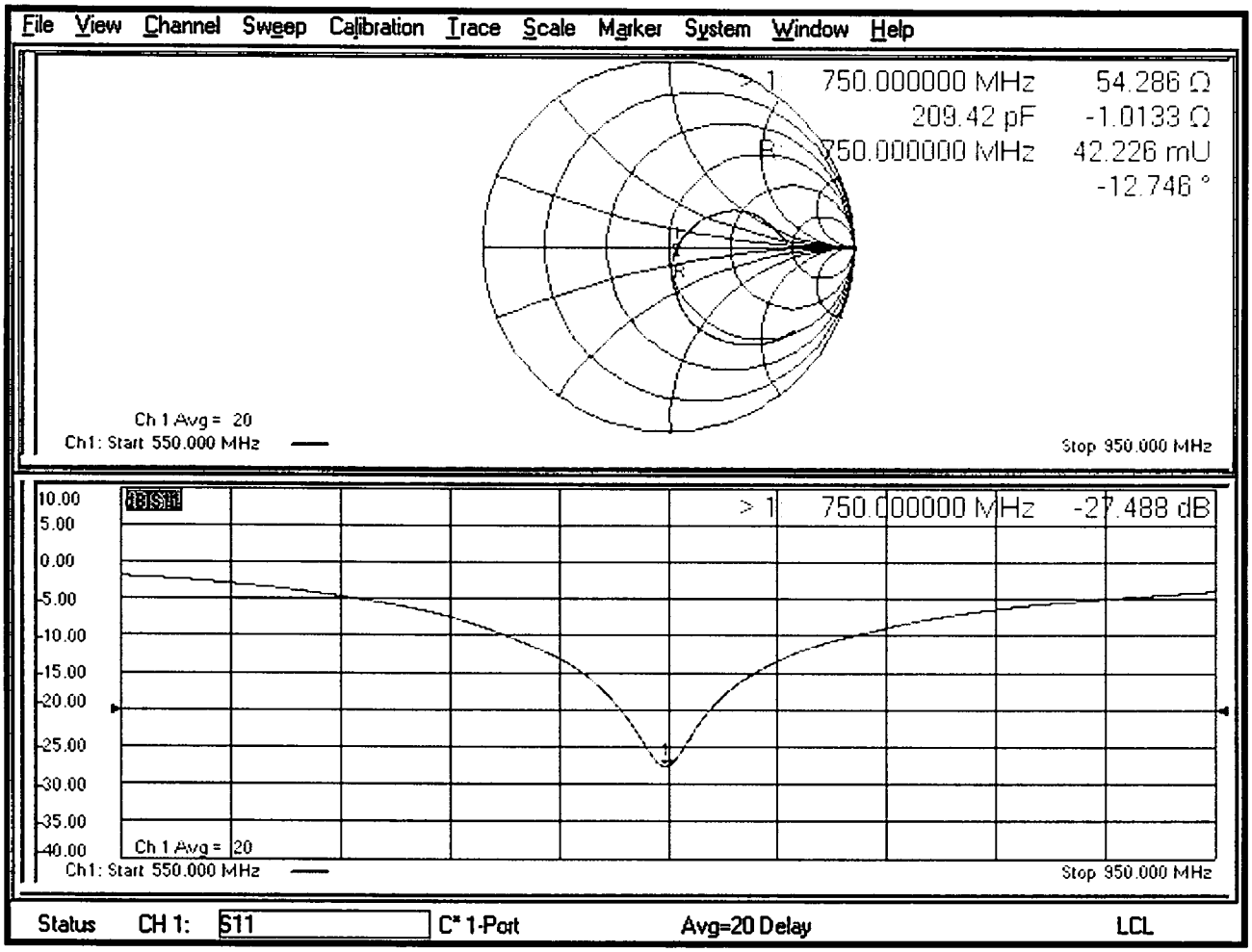
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 60.95 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 3.31 W/kg
SAR(1 g) = 2.17 W/kg; SAR(10 g) = 1.42 W/kg
Smallest distance from peaks to all points 3 dB below = 17 mm
Ratio of SAR at M2 to SAR at M1 = 65.5%
Maximum value of SAR (measured) = 2.90 W/kg



0 dB = 2.90 W/kg = 4.62 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 09.10.2023

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1235

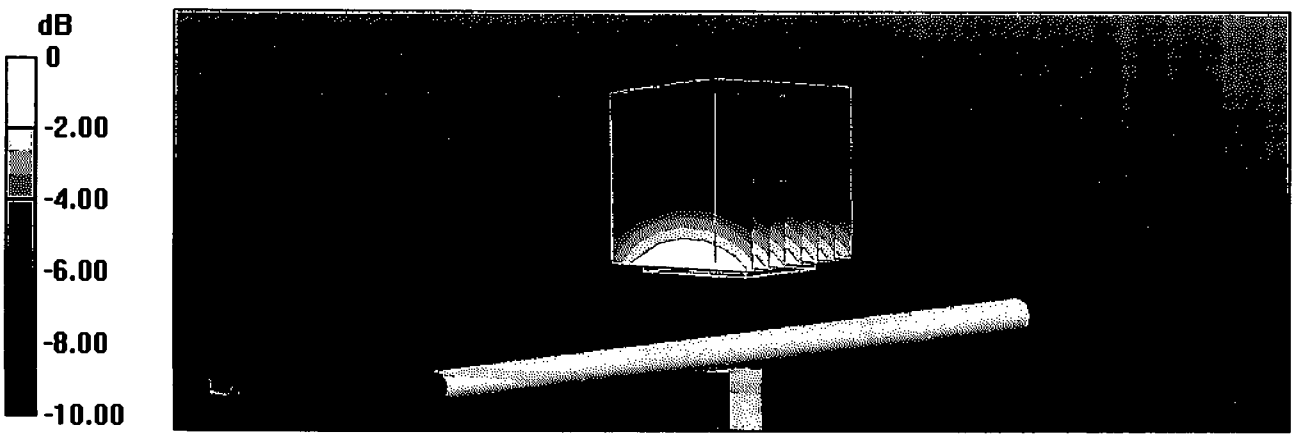
Communication System: UID 0 - CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; σ = 0.95 S/m; ε_r = 55.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.23, 10.23, 10.23) @ 750 MHz; Calibrated: 10.01.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 03.10.2023
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

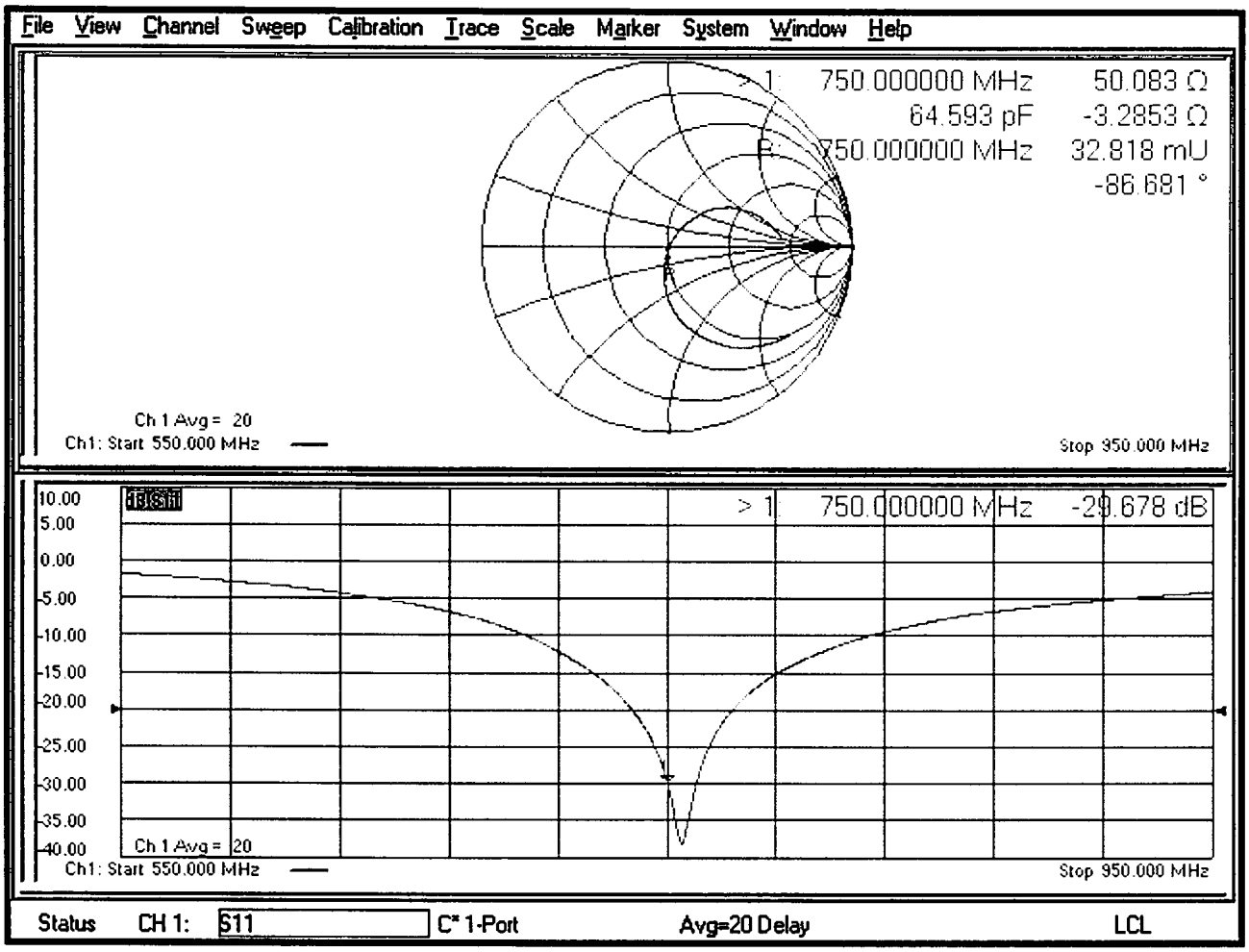
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 55.70 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 3.30 W/kg
SAR(1 g) = 2.16 W/kg; SAR(10 g) = 1.42 W/kg
Smallest distance from peaks to all points 3 dB below = 16 mm
Ratio of SAR at M2 to SAR at M1 = 66%
Maximum value of SAR (measured) = 2.89 W/kg



0 dB = 2.89 W/kg = 4.62 dBW/kg

Impedance Measurement Plot for Body TSL



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IN-HOUSE SAR VERIFICATION SOURCE CALIBRATION EXTENSION

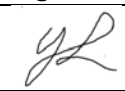
Object	D750V3 – SN: 1235
Description	SAR Validation Dipole at 750 MHz
Procedure (s)	Procedure for SAR Verification Source Calibration Extension
In-house Check Date	11/7/2024

Equipment List

Manufacturer	Model	Description	Serial Number	Calibration Date	Calibration Due	CBT
Rohde & Schwarz	ZNL20	Vector Network Analyzer	101202	9/12/2024	9/12/2025	
Rohde & Schwarz	ZN-Z135	Calibration Kit	5000-309192839	10/31/24	10/31/26	
Control Company	4040	Ambient Thermometer	230581657	8/28/2023	8/28/2025	
Control Company	4352	Long Stem Liquid Thermometer	230662223	9/28/2023	9/28/2025	
Micro-Coax	UFB205A-0-0240-30x30	SMA M-F RF test Cable (DC - 18 GHz)	-			✓
Mini-Circuits	BW-N20W20+	20dB RF Fixed Attenuator (DC - 18 GHz)	-			✓
Mini-Circuits	NF-SF50+	RF Adapter N Male to SMA Female (DC - 18 GHz)	-			✓
SPEAG	DAE4ip	Data Acquisition Electronics with Integ. Power	1839	8/14/2024	8/14/2025	
SPEAG	DAK-3.5	DAK-3.5 Dielectric Probe	1349	9/2/2024	9/2/2025	
SPEAG	EX3DV4	SAR Measurement Probe	7836	3/15/2024	3/15/2025	
SPEAG	Powersource1	Signal Generator	4341	1/5/2024	1/5/2025	

CBT: Components calibrated before testing. Prior to testing, the measurement paths containing a cable, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator, power sensor, or VNA) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.

Measurement Uncertainty = ±27% (k=2)

	Name	Function	Signature
Tested By:	Yue Li	Engineer	
Approved By:	Phuong Nguyen	Technical Manager	

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Per FCC KDB Publication 865664 D01, dipole can have longer calibration intervals of up to three years when it is demonstrated that the SAR target, impedance and return loss of the dipole have remained stable according to the following requirements:

1. Measured SAR does not deviate from the calibrated SAR value by more than 10%.
2. Return loss does not deviate by more than 20% from the previous measurement (i.e. value in dB x 0.2) and meet the required minimum return-loss.
3. Real and imaginary part of the impedance do not deviate by more than 5 Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have an extended calibration interval:

Dipole SN	Freq (MHz)	In-house Check Date	Cal Date	Head SAR target (1g) @ 30dBm (W/kg)	Measured Head SAR (1g) @ 17dBm (W/kg)	1g SAR Deviation (%)	Head SAR target (10g) @ 30dBm (W/kg)	Measured Head SAR (10g) @ 17dBm (W/kg)	10g SAR Deviation (%)	Cert Head Impedance (Ohm) - Real	Measured Head Impedance (Ohm) - Real	Head Impedance Deviation (Ohm) - Real	Cert Head Impedance (Ohm) - Imaginary	Measured Head Impedance (Ohm) - Imaginary	Head Impedance Deviation (Ohm) - Imaginary	Cert Head Return Loss (dB)	Measured Head Return Loss (dB)	Return Loss Deviation (%)	PASS/FAIL
1235	750	11/7/2024	10/11/2023	8.69	0.44	0.80%	5.69	0.29	1.34%	54.3	54.8	0.5	-1.0	0.4	1.4	-27.5	-26.8	17.22%	PASS

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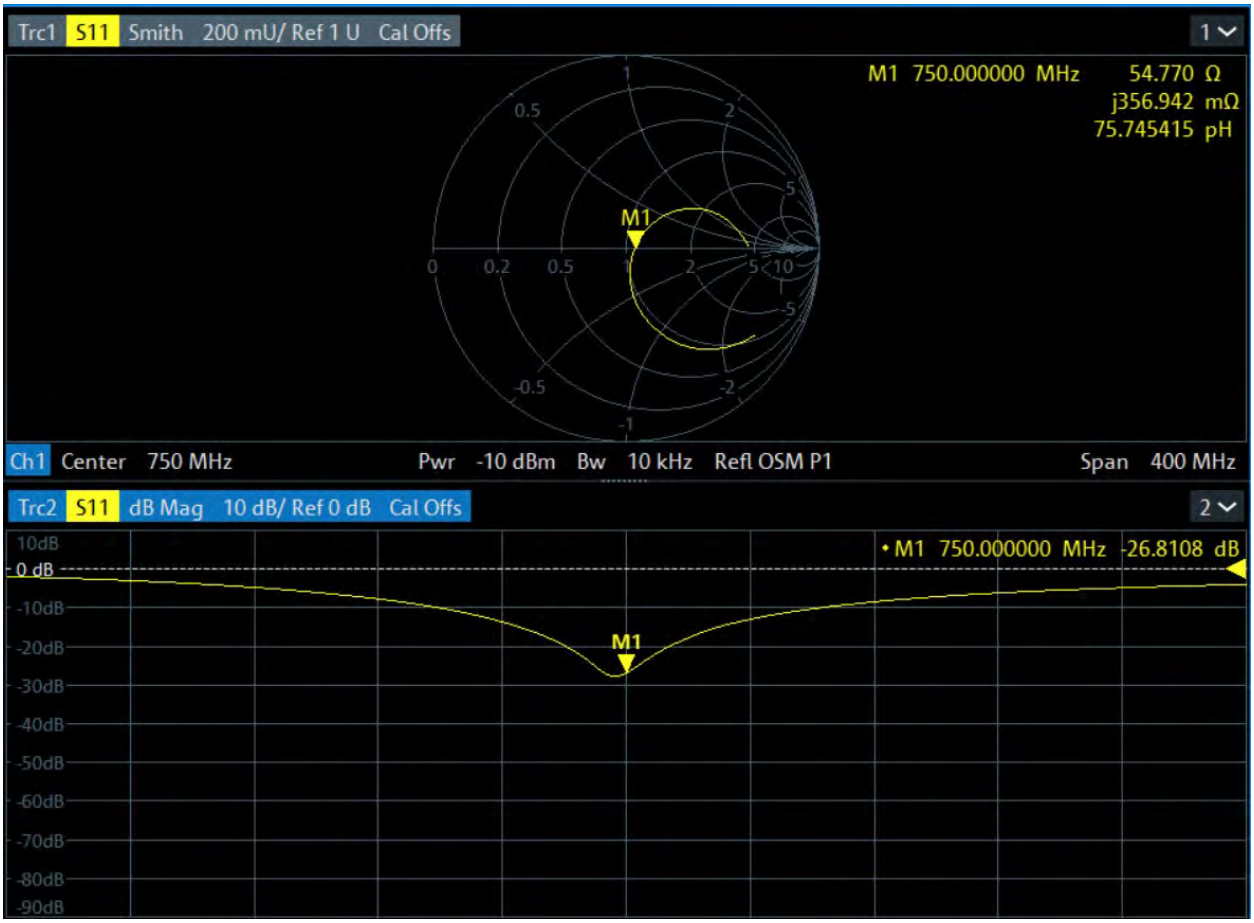
Impedance and Return-Loss Measurement Plot for Head TSL



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IN-HOUSE SAR VERIFICATION SOURCE CALIBRATION EXTENSION

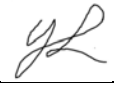
Object	D750V3 – SN: 1235
Description	SAR Validation Dipole at 750 MHz
Procedure (s)	Procedure for SAR Verification Source Calibration Extension
In-house Check Date	07/30/2025

Equipment List

Manufacturer	Model	Description	Serial Number	Calibration Date	Calibration Due	CBT
Rohde & Schwarz	ZNL20	Vector Network Analyzer	101202	9/12/2024	9/12/2025	
Rohde & Schwarz	ZN-Z135	Calibration Kit	5000-309192839	10/31/24	10/31/26	
Control Company	4040	Ambient Thermometer	230581657	8/28/2023	8/28/2025	
Control Company	4040	Ambient Thermometer	230581662	8/28/2023	8/28/2025	
Control Company	4352	Long Stem Liquid Thermometer	230662223	9/28/2023	9/28/2025	
Control Company	4352	Long Stem Liquid Thermometer	230662212	9/28/2023	9/28/2025	
Micro-Coax	UFB205A-0-0240-30x30	SMA M-F RF test Cable (DC - 18 GHz)	-			✓
Maury-Micro	360D	10dB RF Fixed Attenuator (DC - 18 GHz) + Short Circuit Termination	7799	12/28/2024	12/28/2025	
Huber+Suhner	SF126	High Performance RF Cable	570292/126			✓
SPEAG	DAE4ip	Data Acquisition Electronics with Integ. Power	1844	11/6/2024	11/6/2025	
SPEAG	DAK-3.5	DAK-3.5 Dielectric Probe	1349	9/2/2024	9/2/2025	
SPEAG	EX3DV4	SAR Measurement Probe	7853	11/7/2024	11/7/2025	
SPEAG	Powersource1	Signal Generator	4341	1/9/2025	1/9/2026	

CBT: Components calibrated before testing. Prior to testing, the measurement paths containing a cable, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator, power sensor, or VNA) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.

Measurement Uncertainty = ±27% (k=2)

	Name	Function	Signature
Tested By:	YL	Engineer	
Approved By:	PN	Technical Manager	

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Per FCC KDB Publication 865664 D01, dipole can have longer calibration intervals of up to three years when it is demonstrated that the SAR target, impedance and return loss of the dipole have remained stable according to the following requirements:

1. Measured SAR does not deviate from the calibrated SAR value by more than 10%.
2. Return loss does not deviate by more than 20% from the previous measurement (i.e. value in dB x 0.2) and meet the required minimum return-loss.
3. Real and imaginary part of the impedance do not deviate by more than 5 Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have an extended calibration interval:

Dipole SN	Freq (MHz)	In-house Check Date	Cal Date	Head SAR target (1g) @ 30dBm (W/kg)	Measured Head SAR (1g) @ 17dBm (W/kg)	1g SAR Dev (%)	Head SAR target (10g) @ 30dBm (W/kg)	Measured Head SAR (10g) @ 17dBm (W/kg)	10g SAR Dev(%)	Cert Head Impedance (Ohm) - Real	Previous Head Impedance (Ohm) - Real	Measured Head Impedance (Ohm) - Real	Head Impedance Deviation (Ohm) - Real	Cert Head Impedance (Ohm) - Imaginary	Previous Head Impedance (Ohm) - Imaginary	Measured Head Impedance (Ohm) - Imaginary	Head Impedance Deviation (Ohm) - Imaginary	Cert Head Return Loss (dB)	Previous Head Return Loss (dB)	Measured Head Return Loss (dB)	Return Loss Dev (%)	PASS/FAIL
1235	750	11/7/2024	10/11/2023	8.69	0.44	0.80%	5.69	0.29	1.34%	54.3	54.3	54.8	0.5	-1.0	-1.0	0.4	1.4	-27.5	-27.5	-26.8	17.22%	PASS
1235	750	7/30/2025	10/11/2023	8.69	0.42	-4.25%	5.69	0.27	-3.92%	54.3	54.8	54.6	-0.2	-1.0	0.4	-1.3	-1.7	-27.5	-26.8	-26.8	1.04%	PASS

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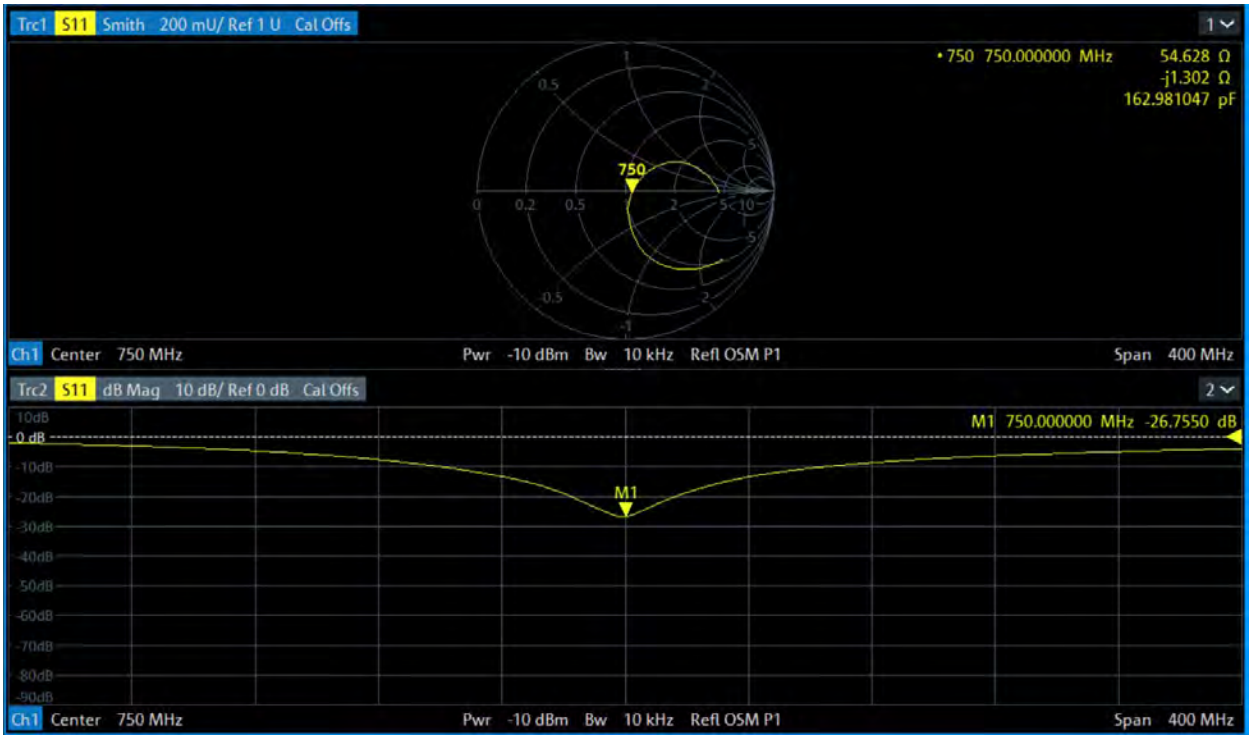
Impedance and Return-Loss Measurement Plot for Head TSL



Calibration Laboratory of
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Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client **RF Safety Lab**
Catonsville, USA

Certificate No. **D5GHzV2-1396_Nov24**

CALIBRATION CERTIFICATE

Object D5GHzV2 - SN: 1396

MAB 11/21/24

Calibration procedure(s) QA CAL-22.v7
Calibration Procedure for SAR Validation Sources between 3 - 10 GHz

Calibration date November 15, 2024

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Cal
Power Sensor R&S NRP-33T	SN: 100967	28-Mar-24 (No. 217-04038)	Mar-25
Power Sensor R&S NRP18A	SN: 101859	22-Jul-24 (No. 4030A315008547)	Jul-25
Spectrum Analyzer R&S FSV40	SN: 101832	25-Jan-24 (No. 4030-315007551)	Jan-25
Mismatch; Short [S4188] Attenuator [S4423]	SN: 1152	28-Mar-24 (No. 217-04050)	Mar-25
OCP DAK-12	SN: 1016	24-Sep-24 (No. OCP-DAK12-1016_Sep24)	Sep-25
OCP DAK-3.5	SN: 1249	23-Sep-24 (No. OCP-DAK3.5-1249_Sep24)	Sep-25
Reference Probe EX3DV4	SN: 7349	03-Jun-24 (No. EX3-7349_Jun24)	Jun-25
DAE4ip	SN: 1836	28-Oct-24 (No. DAE4ip-1836_Oct24)	Oct-25

Secondary Standards	ID	Check Date (in house)	Scheduled Check
ACAD Source Box	SN: 1000	28-May-24 (No. 675-ACAD_Source_Box-240528)	May-25
Signal Generator R&S SMB100A	SN: 182081	28-May-24 (No. 675-CAL16-S4588-240528)	May-25
Mismatch; SMA	SN: 1102	22-May-24 (No. 675-Mismatch_SMA-240522)	May-25

	Name	Function	Signature
Calibrated by	Paulo Pina	Laboratory Technician	
Approved by	Sven Kühn	Technical Manager	

Issued: November 15, 2024

Calibration Laboratory of
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Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Glossary

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards

- IEC/IEEE 62209-1528,"Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation

- DASY System Handbook

Methods Applied and Interpretation of Parameters

- *Measurement Conditions*: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL*: The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss*: These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay*: One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured*: SAR measured at the stated antenna input power.
- *SAR normalized*: SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters*: The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY8 Module SAR	16.4.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with spacer
Zoom Scan Resolution	dx, dy = 4mm, dz = 1.4mm	Graded Ratio = 1.4 mm (Z direction)
Frequency	5250MHz ±1MHz 5600MHz ±1MHz 5750MHz ±1MHz 5850MHz ±1MHz	

Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ±0.2)°C	36.1 ±6%	4.55 mho/m ±6%
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	20 dBm input power	7.79 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	77.9 W/kg ±19.9% (k = 2)

SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	20 dBm input power	2.24 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.4 W/kg ±19.5% (k = 2)

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ±0.2)°C	35.5 ±6%	4.91 mho/m ±6%
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	20 dBm input power	8.11 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.1 W/kg ±19.9% (k = 2)

SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	20 dBm input power	2.33 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.3 W/kg ±19.5% (k = 2)

Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ±0.2)°C	35.3 ±6%	5.08 mho/m ±6%
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	20 dBm input power	8.01 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.1 W/kg ±19.9% (k = 2)

SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	20 dBm input power	2.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.8 W/kg ±19.5% (k = 2)

Head TSL parameters at 5850 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.2	5.32 mho/m
Measured Head TSL parameters	(22.0 ±0.2)°C	35.2 ±6%	5.18 mho/m ±6%
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL at 5850 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	20 dBm input power	7.69 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	76.9 W/kg ±19.9% (k = 2)

SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	20 dBm input power	2.20 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.0 W/kg ±19.5% (k = 2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5250 MHz

Impedance	46.9 Ω – 1.3 jΩ
Return Loss	-29.1 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance	53.9 Ω + 3.2 jΩ
Return Loss	-26.2 dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance	51.8 Ω + 2.6 jΩ
Return Loss	-30.1 dB

Antenna Parameters with Head TSL at 5850 MHz

Impedance	54.7 Ω – 1.0 jΩ
Return Loss	-26.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.189 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard. No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

System Performance Check Report

Summary

Dipole	Frequency [MHz]	TSL	Power [dBm]
D5GHzV2 – SN1396	5250	HSL	20

Exposure Conditions

Phantom Section, TSL	Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor	TSL Conductivity [S/m]	TSL Permittivity
Flat	10		CW, 0—	5250, 0	5.39	4.55	36.1

Hardware Setup

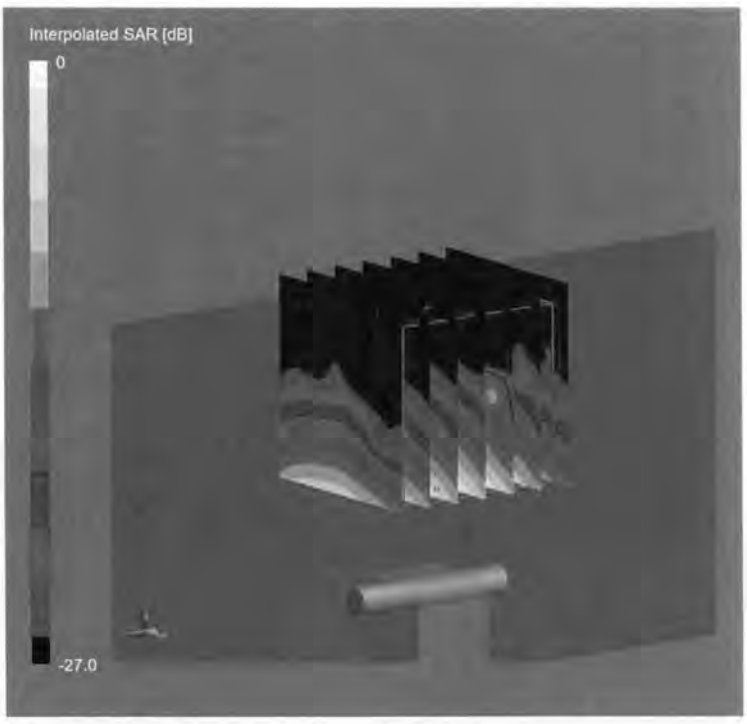
Phantom	TSL, Measured Date	Probe, Calibration Date	DAE, Calibration Date
MFP V8.0 Center	HSL, 2024-11-15	EX3DV4 – SN7349, 2024-06-03	DAE4ip Sn1836, 2024-10-28

Scans Setup

	Zoom Scan
Grid Extents [mm]	22 x 22 x 22
Grid Steps [mm]	4.0 x 4.0 x 1.4
Sensor Surface [mm]	1.4
Graded Grid	Yes
Grading Ratio	1.4
MAIA	N/A
Surface Detection	VMS + 6p
Scan Method	Measured

Measurement Results

	Zoom Scan
Date	2024-11-15
psSAR1g [W/Kg]	7.79
psSAR10g [W/Kg]	2.24
Power Drift [dB]	0.03
Power Scaling	Disabled
Scaling Factor [dB]	
TSL Correction	Positive / Negative



0 dB = 31.1 W/Kg

System Performance Check Report

Summary

Dipole	Frequency [MHz]	TSL	Power [dBm]
D5GHzV2 - SN1396	5600	HSL	20

Exposure Conditions

Phantom Section, TSL	Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor	TSL Conductivity [S/m]	TSL Permittivity
Flat	10		CW, 0--	5600, 0	4.93	4.91	35.5

Hardware Setup

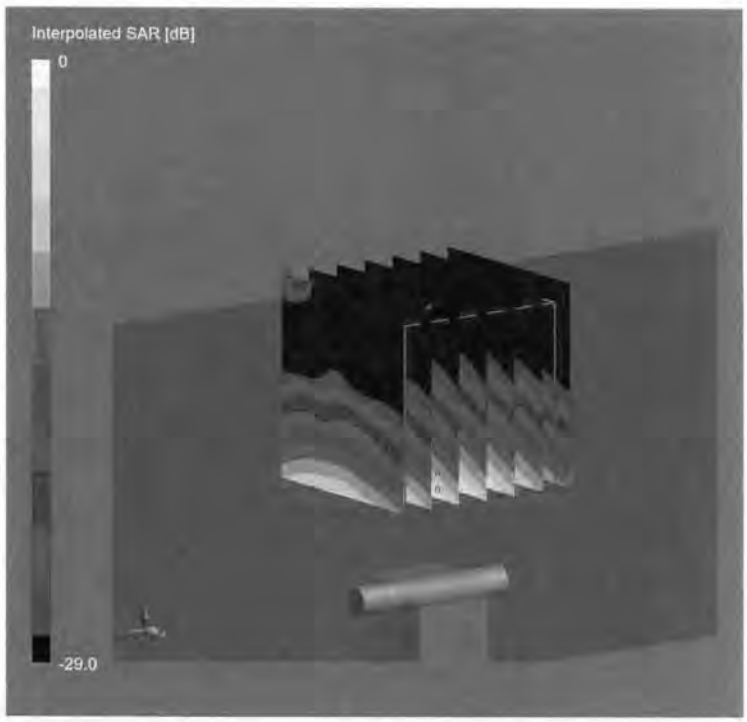
Phantom	TSL, Measured Date	Probe, Calibration Date	DAE, Calibration Date
MFP V8.0 Center	HSL, 2024-11-15	EX3DV4 - SN7349, 2024-06-03	DAE4ip Sn1836, 2024-10-28

Scans Setup

	Zoom Scan
Grid Extents [mm]	22 x 22 x 22
Grid Steps [mm]	4.0 x 4.0 x 1.4
Sensor Surface [mm]	1.4
Graded Grid	Yes
Grading Ratio	1.4
MAIA	N/A
Surface Detection	VMS + 6p
Scan Method	Measured

Measurement Results

	Zoom Scan
Date	2024-11-15
psSAR1g [W/Kg]	8.11
psSAR10g [W/Kg]	2.33
Power Drift [dB]	0.00
Power Scaling	Disabled
Scaling Factor [dB]	
TSL Correction	Positive / Negative



0 dB = 35.0 W/Kg

System Performance Check Report

Summary

Dipole	Frequency [MHz]	TSL	Power [dBm]
D5GHzV2 - SN1396	5750	HSL	20

Exposure Conditions

Phantom Section, TSL	Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor	TSL Conductivity [S/m]	TSL Permittivity
Flat	10		CW, 0--	5750, 0	4.93	5.08	35.3

Hardware Setup

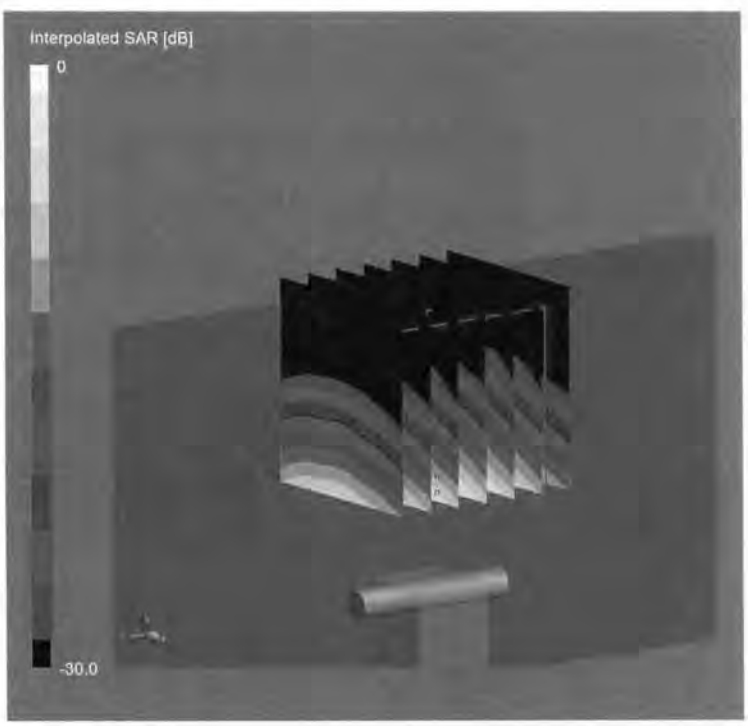
Phantom	TSL, Measured Date	Probe, Calibration Date	DAE, Calibration Date
MFP V8.0 Center	HSL, 2024-11-15	EX3DV4 - SN7349, 2024-06-03	DAE4ip Sn1836, 2024-10-28

Scans Setup

	Zoom Scan
Grid Extents [mm]	22 x 22 x 22
Grid Steps [mm]	4.0 x 4.0 x 1.4
Sensor Surface [mm]	1.4
Graded Grid	Yes
Grading Ratio	1.4
MAIA	N/A
Surface Detection	VMS + 6p
Scan Method	Measured

Measurement Results

	Zoom Scan
Date	2024-11-15
psSAR1g [W/Kg]	8.01
psSAR10g [W/Kg]	2.28
Power Drift [dB]	0.00
Power Scaling	Disabled
Scaling Factor [dB]	
TSL Correction	Positive / Negative



0 dB = 35.6 W/Kg

System Performance Check Report

Summary

Dipole	Frequency [MHz]	TSL	Power [dBm]
D5GHzV2 - SN1396	5850	HSL	20

Exposure Conditions

Phantom Section, TSL	Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor	TSL Conductivity [S/m]	TSL Permittivity
Flat	10		CW, 0--	5850, 0	4.96	5.18	35.2

Hardware Setup

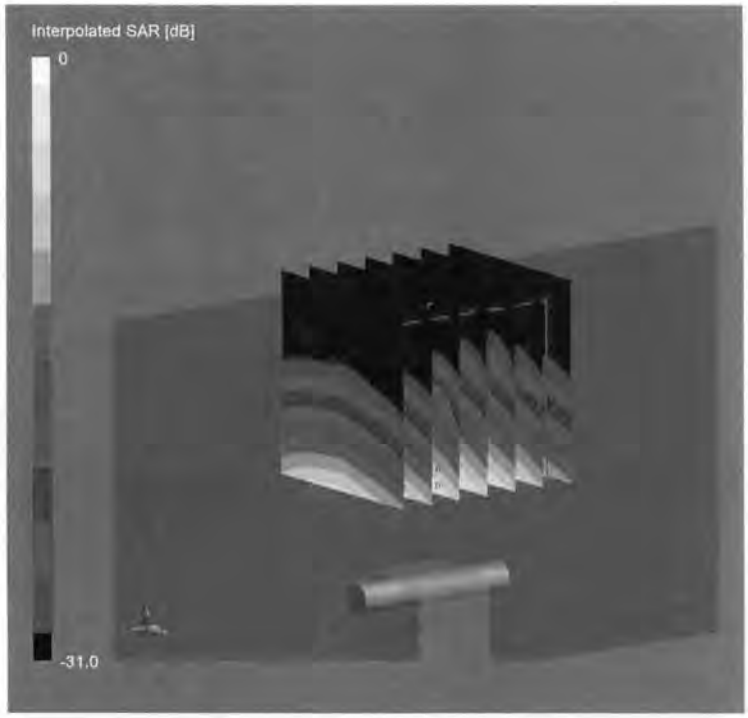
Phantom	TSL, Measured Date	Probe, Calibration Date	DAE, Calibration Date
MFP V8.0 Center	HSL, 2024-11-15	EX3DV4 - SN7349, 2024-06-03	DAE4ip Sn1836, 2024-10-28

Scans Setup

	Zoom Scan
Grid Extents [mm]	22 x 22 x 22
Grid Steps [mm]	4.0 x 4.0 x 1.4
Sensor Surface [mm]	1.4
Graded Grid	Yes
Grading Ratio	1.4
MAIA	N/A
Surface Detection	VMS + 6p
Scan Method	Measured

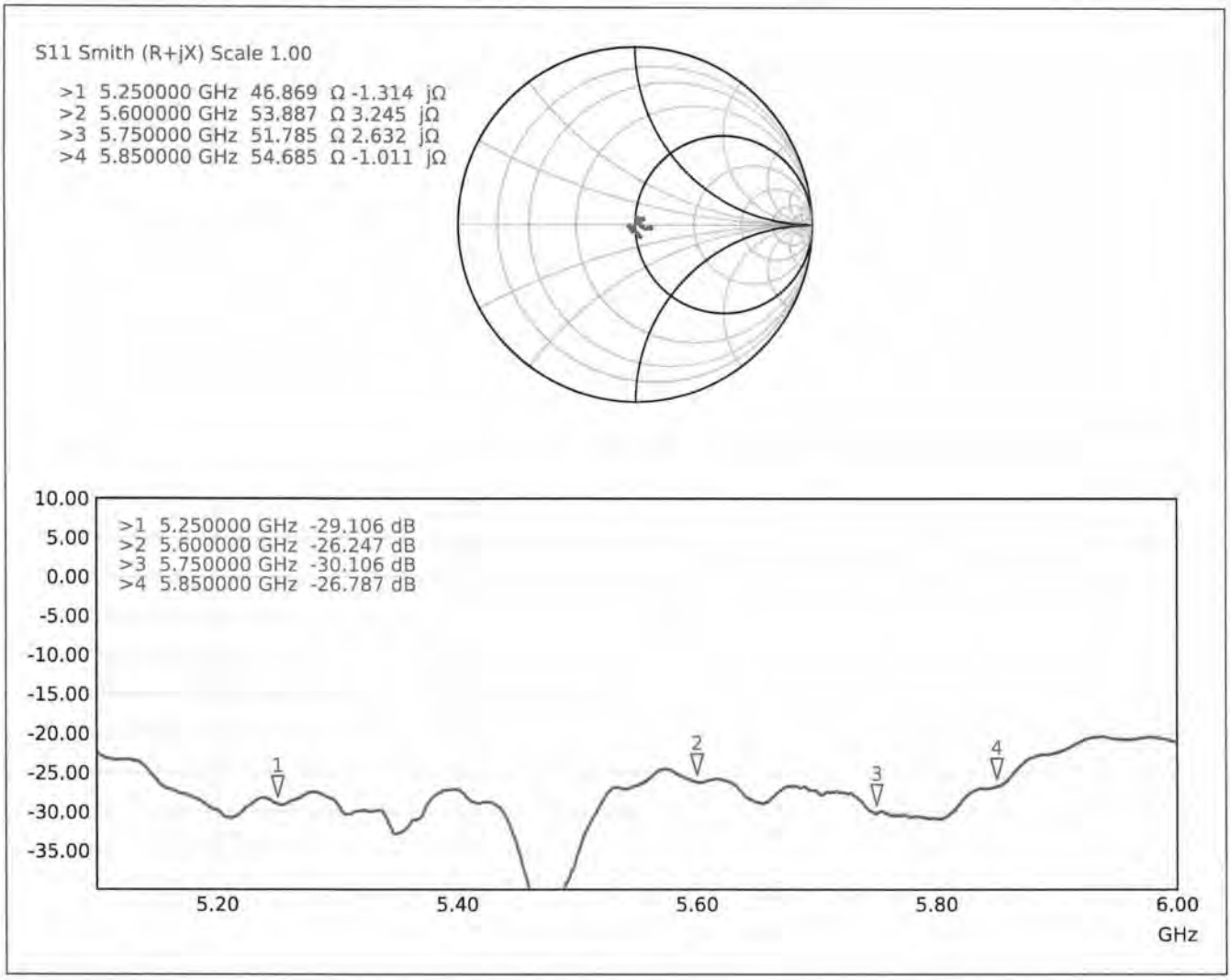
Measurement Results

	Zoom Scan
Date	2024-11-15
psSAR1g [W/Kg]	7.69
psSAR10g [W/Kg]	2.20
Power Drift [dB]	0.00
Power Scaling	Disabled
Scaling Factor [dB]	
TSL Correction	Positive / Negative



0 dB = 34.8 W/Kg

Impedance Measurement Plot for Head TSL



RF SAFETY LAB
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IN-HOUSE SAR VERIFICATION SOURCE CALIBRATION EXTENSION

Object	D5GHzV2 – SN: 1396
Description	SAR Validation Dipole at 5250, 5600, 5750, and 5850 MHz
Procedure (s)	Procedure for SAR Verification Source Calibration Extension
In-house Check Date	07/30/2025

Equipment List

Manufacturer	Model	Description	Serial Number	Calibration Date	Calibration Due	CBT
Rohde & Schwarz	ZNL20	Vector Network Analyzer	101202	9/12/2024	9/12/2025	
Rohde & Schwarz	ZN-Z135	Calibration Kit	5000-309192839	10/31/24	10/31/26	
Control Company	4040	Ambient Thermometer	230581657	8/28/2023	8/28/2025	
Control Company	4040	Ambient Thermometer	230581662	8/28/2023	8/28/2025	
Control Company	4352	Long Stem Liquid Thermometer	230662223	9/28/2023	9/28/2025	
Control Company	4352	Long Stem Liquid Thermometer	230662212	9/28/2023	9/28/2025	
Micro-Coax	UFB205A-0-0240-30x30	SMA M-F RF test Cable (DC - 18 GHz)	-			✓
Maury-Micro	360D	10dB RF Fixed Attenuator (DC - 18 GHz) + Short Circuit Termination	7799	12/28/2024	12/28/2025	
Huber+Suhner	SF126	High Performance RF Cable	570292/126			✓
SPEAG	DAE4ip	Data Acquisition Electronics with Integ. Power	1839	9/4/2024	9/4/2025	
SPEAG	DAK-3.5	DAK-3.5 Dielectric Probe	1349	9/2/2024	9/2/2025	
SPEAG	EX3DV4	SAR Measurement Probe	7836	9/12/2024	9/12/2025	
SPEAG	Powersource1	Signal Generator	4341	1/9/2025	1/9/2026	

CBT: Components calibrated before testing. Prior to testing, the measurement paths containing a cable, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator, power sensor, or VNA) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.

Measurement Uncertainty = ±27% (k=2)

	Name	Function	Signature
Tested By:	Yue Li	Engineer	
Approved By:	Phuong Nguyen	Technical Manager	

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Per FCC KDB Publication 865664 D01, dipole can have longer calibration intervals of up to three years when it is demonstrated that the SAR target, impedance and return loss of the dipole have remained stable according to the following requirements:

1. Measured SAR does not deviate from the calibrated SAR value by more than 10%.
2. Return loss does not deviate by more than 20% from the previous measurement (i.e. value in dB x 0.2) and meet the required minimum return-loss.
3. Real and imaginary part of the impedance do not deviate by more than 5 Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have an extended calibration interval:

Dipole SN	Freq (MHz)	In-house Check Date	Cal Date	Head SAR target (1g) @ 20dBm (W/kg)	Measured Head SAR (1g) @ 17dBm (W/kg)	1g SAR Dev (%)	Head SAR target (10g) @ 20dBm (W/kg)	Measured Head SAR (10g) @ 17dBm (W/kg)	10g SAR Dev(%)	Cert Head Impedance (Ohm) - Real	Previous Head Impedance (Ohm) - Real	Measured Head Impedance (Ohm) - Real	Head Impedance Deviation (Ohm) - Real	Cert Head Impedance (Ohm) - Imaginary	Previous Head Impedance (Ohm) - Imaginary	Measured Head Impedance (Ohm) - Imaginary	Head Impedance Deviation (Ohm) - Imaginary	Cert Head Return Loss (dB)	Previous Head Return Loss (dB)	Measured Head Return Loss (dB)	Return Loss Dev (%)	PASS/FAIL	Note
1396	5250	11/15/2024	11/15/2024	[redacted]						46.8	46.9	46.8	-0.1	-1.3	-1.3	-1.3	0.0	-29.1	-29.1	-29.1	-0.03%	PASS	In-house check after Calibration
1396	5600	11/15/2024	11/15/2024							53.9	53.9	54.1	0.2	3.2	3.2	3.3	0.1	-26.2	-26.2	-25.9	1.03%	PASS	In-house check after Calibration
1396	5750	11/15/2024	11/15/2024							51.8	51.8	51.9	0.1	2.6	2.6	2.5	-0.1	-30.1	-30.1	-30.2	-0.07%	PASS	In-house check after Calibration
1396	5850	11/15/2024	11/15/2024							54.7	54.7	54.2	-0.5	-1.0	-1.0	-1.1	-0.1	-26.8	-26.8	-26.9	-0.38%	PASS	In-house check after Calibration
1396	5250	7/30/2025	11/15/2024	77.9	3.77	-3.48%	22.4	3.67	-4.69%	46.9	46.8	47.7	0.9	-1.3	-0.2	-1.5	-1.3	-29.1	-29.5	-29.1	39.90%	PASS	-
1396	5600	7/30/2025	11/15/2024	81.1	4.07	0.13%	23.3	3.93	-1.63%	53.9	53.9	52.9	-0.9	3.2	4.1	3.9	-0.3	-26.2	-25.9	-25.9	-0.97%	PASS	
1396	5750	7/30/2025	11/15/2024	80.1	3.79	-5.59%	22.8	3.68	-5.48%	51.8	51.9	52.1	0.2	2.6	2.5	2.9	0.4	-30.1	-30.2	-29.9	2.42%	PASS	
1396	5850	7/30/2025	11/15/2024	76.9	3.95	2.75%	22	3.72	-1.98%	54.7	54.2	54.2	0.0	-1.0	-2.1	-1.6	0.5	-26.8	-26.9	-27.1	-4.66%	PASS	

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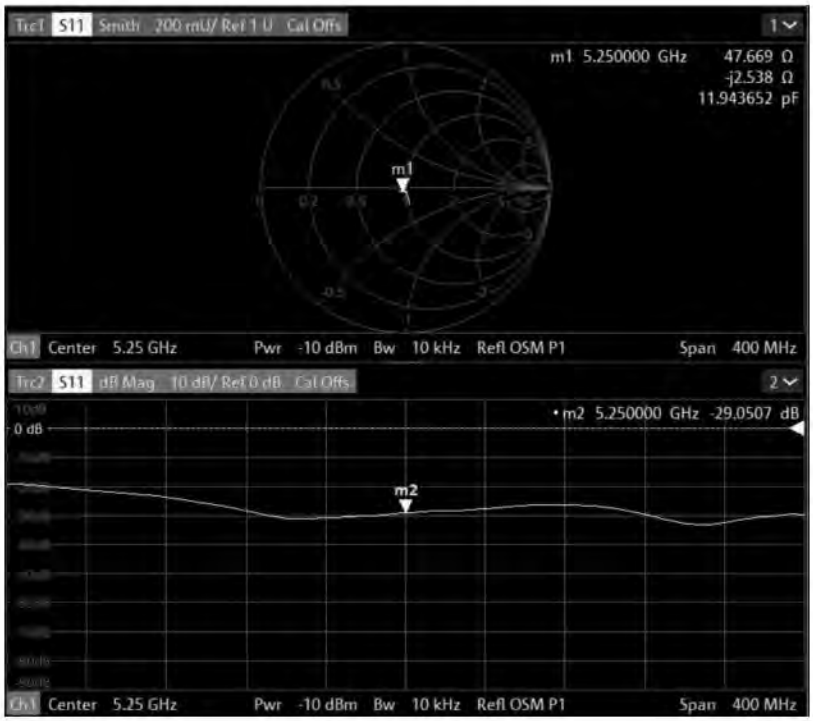
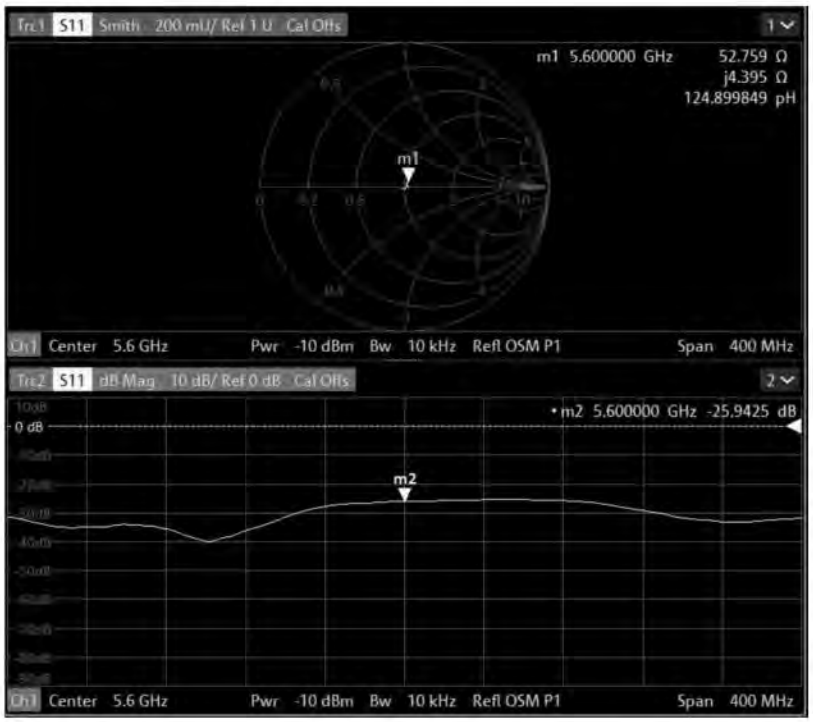
Impedance and Return-Loss Measurement Plot for Head TSL





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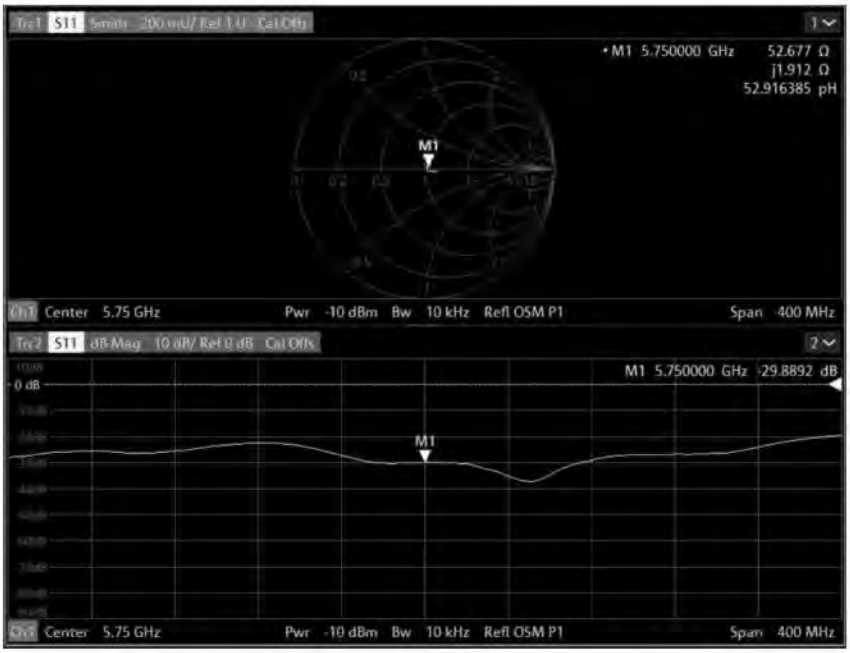

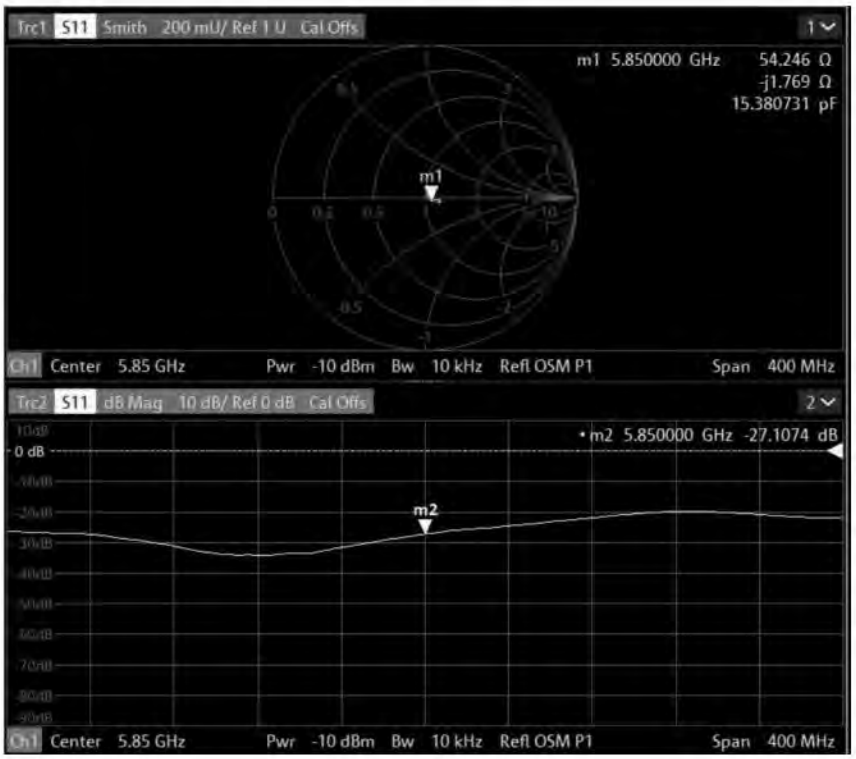

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Accreditation No.: **SCS 0108**

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Client RF Safety Lab
Catonsville, USA

Certificate No. D835V2-4d311_Oct23

CALIBRATION CERTIFICATE

Object: D835V2 - SN:4d311

MAR 11/20/23

Calibration procedure(s): QA CAL-05.v12
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz

Calibration date: October 09, 2023

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP2	SN: 104778	30-Mar-23 (No. 217-03804/03805)	Mar-24
Power sensor NRP-Z91	SN: 103244	30-Mar-23 (No. 217-03804)	Mar-24
Power sensor NRP-Z91	SN: 103245	30-Mar-23 (No. 217-03805)	Mar-24
Reference 20 dB Attenuator	SN: BH9394 (20k)	30-Mar-23 (No. 217-03809)	Mar-24
Type-N mismatch combination	SN: 310982 / 06327	30-Mar-23 (No. 217-03810)	Mar-24
Reference Probe EX3DV4	SN: 7349	10-Jan-23 (No. EX3-7349_Jan23)	Jan-24
DAE4	SN: 900	09-Aug-23 (No. DAE4-900_Aug23)	Aug-24
DAE4	SN: 601	03-Oct-23 (No. DAE4-601_Oct23)	Oct-24

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-22)	In house check: Oct-24
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24

	Name	Function	Signature
Calibrated by:	Paulo Pina	Laboratory Technician	
Approved by:	Sven Kühn	Technical Manager	

Issued: October 11, 2023

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

c) DASY System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.0 ± 6 %	0.92 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.49 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.82 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.61 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**6.37 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.3 ± 6 %	0.98 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.50 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**9.93 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.64 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**6.52 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.9 Ω - 2.4 jΩ
Return Loss	- 32.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.2 Ω - 6.0 jΩ
Return Loss	- 22.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.392 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

DASY5 Validation Report for Head TSL

Date: 03.10.2023

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d311

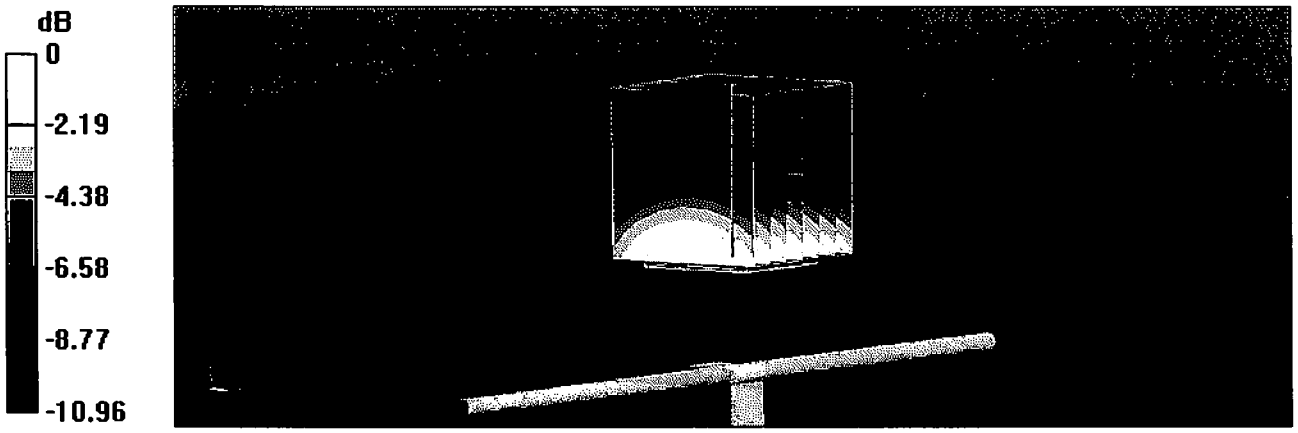
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.92 S/m; ε_r = 42; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(9.69, 9.69, 9.69) @ 835 MHz; Calibrated: 10.01.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn900; Calibrated: 09.08.2023
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

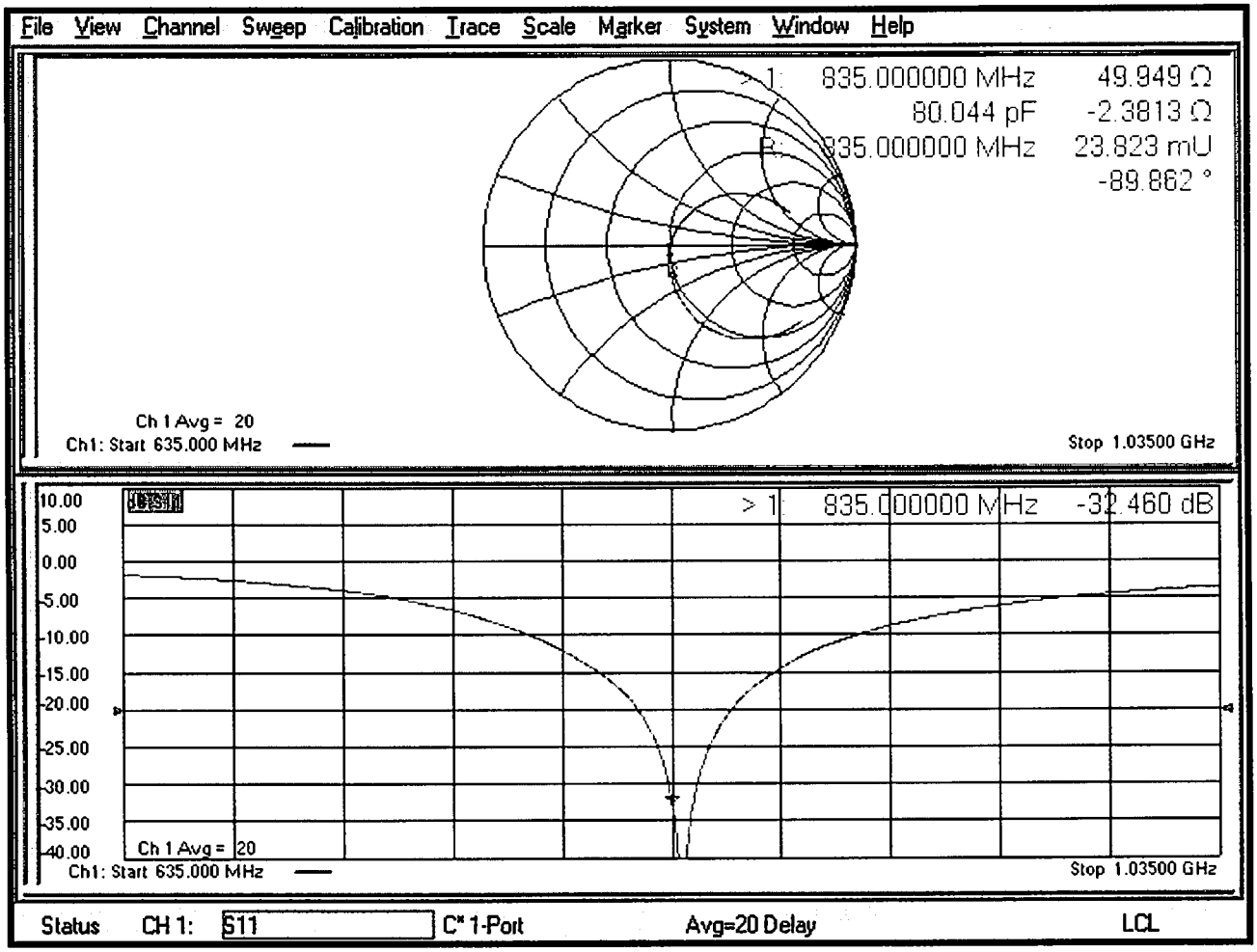
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 64.08 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 3.72 W/kg
SAR(1 g) = 2.49 W/kg; SAR(10 g) = 1.61 W/kg
Smallest distance from peaks to all points 3 dB below = 16 mm
Ratio of SAR at M2 to SAR at M1 = 66.5%
Maximum value of SAR (measured) = 3.30 W/kg



0 dB = 3.30 W/kg = 5.19 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 09.10.2023

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d311

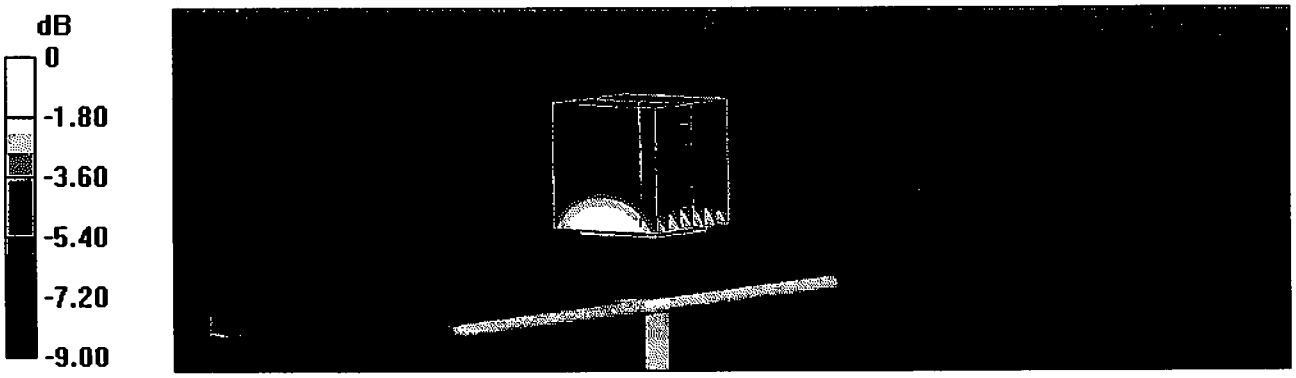
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.98 S/m; ε_r = 55.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(9.85, 9.85, 9.85) @ 835 MHz; Calibrated: 10.01.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 03.10.2023
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

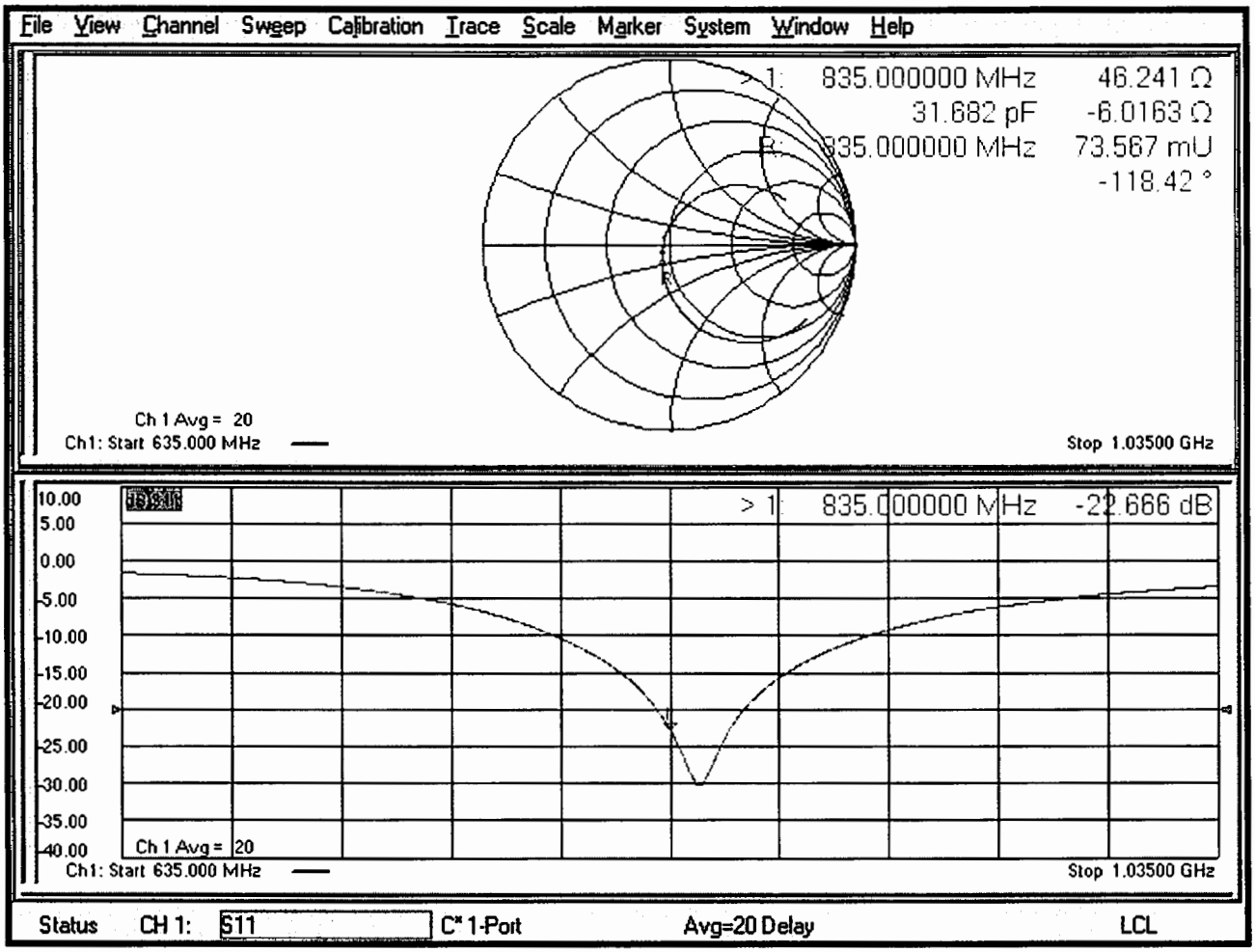
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 58.74 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 3.68 W/kg
SAR(1 g) = 2.50 W/kg; SAR(10 g) = 1.64 W/kg
Smallest distance from peaks to all points 3 dB below = 15.1 mm
Ratio of SAR at M2 to SAR at M1 = 68.2%
Maximum value of SAR (measured) = 3.30 W/kg



0 dB = 3.30 W/kg = 5.19 dBW/kg

Impedance Measurement Plot for Body TSL



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IN-HOUSE SAR VERIFICATION SOURCE CALIBRATION EXTENSION

Object	D835V2 – SN: 4d311
Description	SAR Validation Dipole at 835 MHz
Procedure (s)	Procedure for SAR Verification Source Calibration Extension
In-house Check Date	11/7/2024

Equipment List

Manufacturer	Model	Description	Serial Number	Calibration Date	Calibration Due	CBT
Rohde & Schwarz	ZNL20	Vector Network Analyzer	101202	9/12/2024	9/12/2025	
Rohde & Schwarz	ZN-Z135	Calibration Kit	5000-309192839	10/31/24	10/31/26	
Control Company	4040	Ambient Thermometer	230581657	8/28/2023	8/28/2025	
Control Company	4352	Long Stem Liquid Thermometer	230662223	9/28/2023	9/28/2025	
Micro-Coax	UFB205A-0-0240-30x30	SMA M-F RF test Cable (DC - 18 GHz)	-			✓
Mini-Circuits	BW-N20W20+	20dB RF Fixed Attenuator (DC - 18 GHz)	-			✓
Mini-Circuits	NF-SF50+	RF Adapter N Male to SMA Female (DC - 18 GHz)	-			✓
SPEAG	DAE4ip	Data Acquisition Electronics with Integ. Power	1839	8/14/2024	8/14/2025	
SPEAG	DAK-3.5	DAK-3.5 Dielectric Probe	1349	9/2/2024	9/2/2025	
SPEAG	EX3DV4	SAR Measurement Probe	7836	3/15/2024	3/15/2025	
SPEAG	Powersource1	Signal Generator	4341	1/5/2024	1/5/2025	

CBT: Components calibrated before testing. Prior to testing, the measurement paths containing a cable, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator, power sensor, or VNA) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.

Measurement Uncertainty = ±27% (k=2)

	Name	Function	Signature
Tested By:	Yue Li	Engineer	
Approved By:	Phuong Nguyen	Technical Manager	

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Per FCC KDB Publication 865664 D01, dipole can have longer calibration intervals of up to three years when it is demonstrated that the SAR target, impedance and return loss of the dipole have remained stable according to the following requirements:

1. Measured SAR does not deviate from the calibrated SAR value by more than 10%.
2. Return loss does not deviate by more than 20% from the previous measurement (i.e. value in dB x 0.2) and meet the required minimum return-loss.
3. Real and imaginary part of the impedance do not deviate by more than 5 Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have an extended calibration interval:

Dipole SN	Freq (MHz)	In-house Check Date	Cal Date	Head SAR target (1g) @ 30dBm (W/kg)	Measured Head SAR (1g) @ 17dBm (W/kg)	1g SAR Deviation (%)	Head SAR target (10g) @ 30dBm (W/kg)	Measured Head SAR (10g) @ 17dBm (W/kg)	10g SAR Deviation (%)	Cert Head Impedance (Ohm) - Real	Measured Head Impedance (Ohm) - Real	Head Impedance Deviation (Ohm) - Real	Cert Head Impedance (Ohm) - Imaginary	Measured Head Impedance (Ohm) - Imaginary	Head Impedance Deviation (Ohm) - Imaginary	Cert Head Return Loss (dB)	Measured Head Return Loss (dB)	Return Loss Deviation (%)	PASS/FAIL
4d311	835	11/7/2024	10/9/2023	9.82	0.53	7.48%	6.37	0.35	8.06%	49.9	49.4	-0.5	-2.4	-2.0	0.4	-32.5	-33.4	-18.68%	PASS

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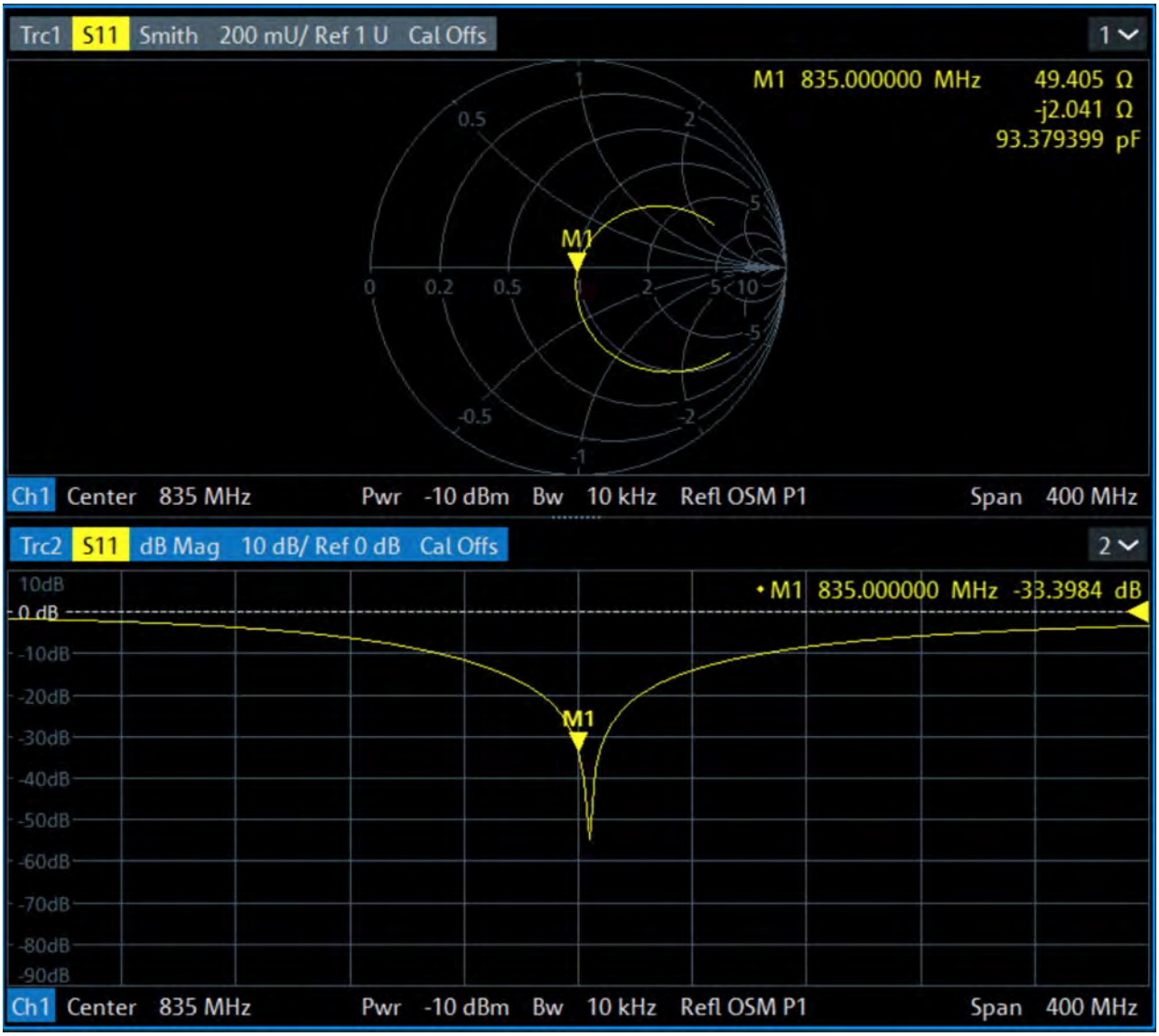
Impedance and Return-Loss Measurement Plot for Head TSL



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IN-HOUSE SAR VERIFICATION SOURCE CALIBRATION EXTENSION

Object	D835V2 – SN: 4d311
Description	SAR Validation Dipole at 835 MHz
Procedure (s)	Procedure for SAR Verification Source Calibration Extension
In-house Check Date	07/29/2025

Equipment List

Manufacturer	Model	Description	Serial Number	Calibration Date	Calibration Due	CBT
Rohde & Schwarz	ZNL20	Vector Network Analyzer	101202	9/12/2024	9/12/2025	
Rohde & Schwarz	ZN-Z135	Calibration Kit	5000-309192839	10/31/24	10/31/26	
Control Company	4040	Ambient Thermometer	230581657	8/28/2023	8/28/2025	
Control Company	4040	Ambient Thermometer	230581662	8/28/2023	8/28/2025	
Control Company	4352	Long Stem Liquid Thermometer	230662223	9/28/2023	9/28/2025	
Control Company	4352	Long Stem Liquid Thermometer	230662212	9/28/2023	9/28/2025	
Micro-Coax	UFB205A-0-0240-30x30	SMA M-F RF test Cable (DC - 18 GHz)	-			✓
Maury-Micro	360D	10dB RF Fixed Attenuator (DC - 18 GHz) + Short Circuit Termination	7799	12/28/2024	12/28/2025	
Huber+Suhner	SF126	High Performance RF Cable	570292/126			✓
SPEAG	DAE4ip	Data Acquisition Electronics with Integ. Power	1839	9/4/2024	9/4/2025	
SPEAG	DAK-3.5	DAK-3.5 Dielectric Probe	1349	9/2/2024	9/2/2025	
SPEAG	EX3DV4	SAR Measurement Probe	7836	9/12/2024	9/12/2025	
SPEAG	Powersource1	Signal Generator	4341	1/9/2025	1/9/2026	

CBT: Components calibrated before testing. Prior to testing, the measurement paths containing a cable, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator, power sensor, or VNA) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.

Measurement Uncertainty = ±27% (k=2)

	Name	Function	Signature
Tested By:	YL	Engineer	
Approved By:	PN	Technical Manager	

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Per FCC KDB Publication 865664 D01, dipole can have longer calibration intervals of up to three years when it is demonstrated that the SAR target, impedance and return loss of the dipole have remained stable according to the following requirements:

1. Measured SAR does not deviate from the calibrated SAR value by more than 10%.
2. Return loss does not deviate by more than 20% from the previous measurement (i.e. value in dB x 0.2) and meet the required minimum return-loss.
3. Real and imaginary part of the impedance do not deviate by more than 5 Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have an extended calibration interval:

Dipole SN	Freq (MHz)	In-house Check Date	Cal Date	Head SAR target (1g) @ 30dBm (W/kg)	Measured Head SAR (1g) @ 17dBm (W/kg)	1g SAR Dev (%)	Head SAR target (10g) @ 30dBm (W/kg)	Measured Head SAR (10g) @ 17dBm (W/kg)	10g SAR Dev(%)	Cert Head Impedance (Ohm) - Real	Previous Head Impedance (Ohm) - Real	Measured Head Impedance (Ohm) - Real	Head Impedance Deviation (Ohm) - Real	Cert Head Impedance (Ohm) - Imaginary	Previous Head Impedance (Ohm) - Imaginary	Measured Head Impedance (Ohm) - Imaginary	Head Impedance Deviation (Ohm) - Imaginary	Cert Head Return Loss (dB)	Previous Head Return Loss (dB)	Measured Head Return Loss (dB)	Return Loss Dev (%)	PASS/FAIL
4d311	835	11/7/2024	10/9/2023	9.82	0.53	7.48%	6.37	0.35	8.06%	49.9	49.9	49.4	-0.5	-2.4	-2.4	-2.0	0.4	-32.5	-32.5	-33.4	-18.68%	PASS
4d311	835	7/29/2025	10/9/2023	9.82	0.51	3.01%	6.37	0.33	3.05%	49.9	49.4	49.7	0.3	-2.4	-2.0	-2.2	-0.2	-32.5	-33.4	-33.0	10.26%	PASS

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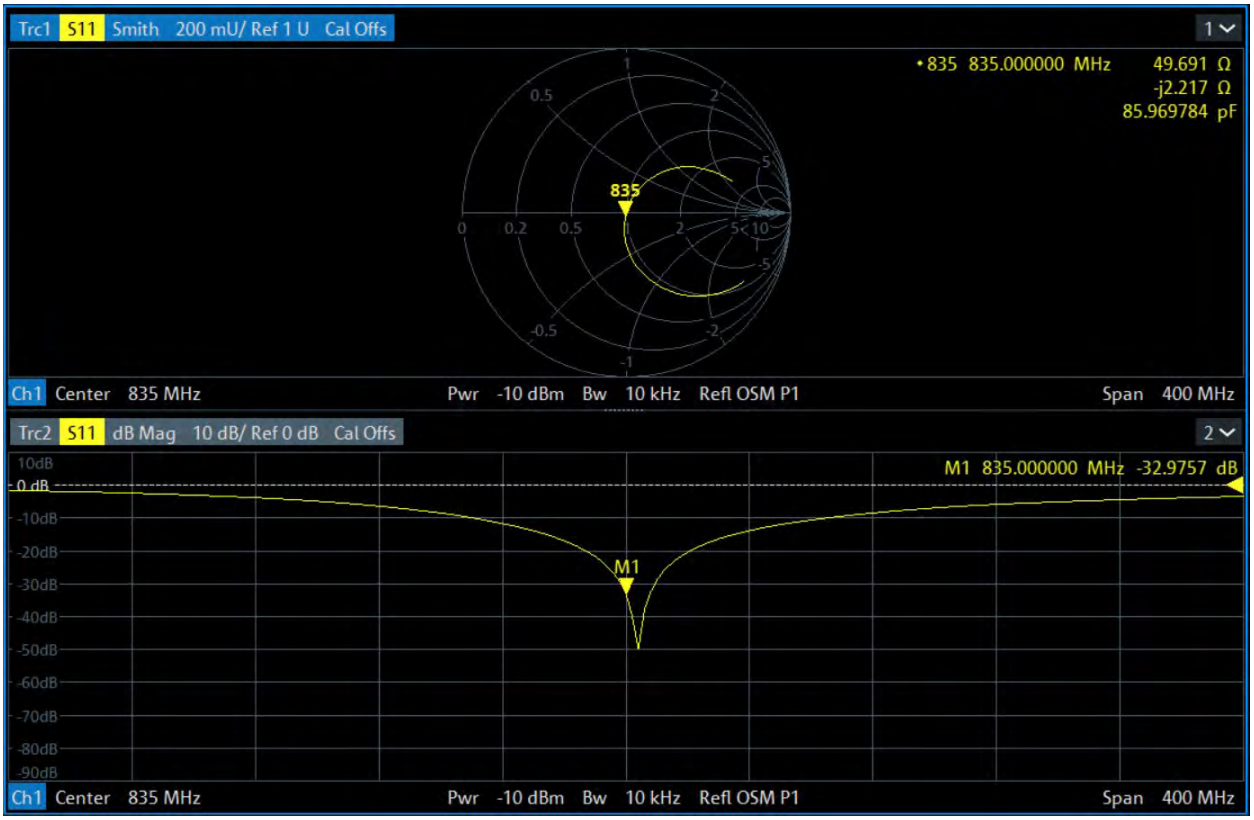
Impedance and Return-Loss Measurement Plot for Head TSL



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S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
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S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client **RF Safety Lab**
Catonsville, USA

Certificate No. **D1900V2-5d252_Oct23**

CALIBRATION CERTIFICATE

Object D1900V2 - SN:5d252

MAB 11/20/23

Calibration procedure(s) QA CAL-05.v12
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz

Calibration date: October 06, 2023

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP2	SN: 104778	30-Mar-23 (No. 217-03804/03805)	Mar-24
Power sensor NRP-Z91	SN: 103244	30-Mar-23 (No. 217-03804)	Mar-24
Power sensor NRP-Z91	SN: 103245	30-Mar-23 (No. 217-03805)	Mar-24
Reference 20 dB Attenuator	SN: BH9394 (20k)	30-Mar-23 (No. 217-03809)	Mar-24
Type-N mismatch combination	SN: 310982 / 06327	30-Mar-23 (No. 217-03810)	Mar-24
Reference Probe EX3DV4	SN: 7349	10-Jan-23 (No. EX3-7349_Jan23)	Jan-24
DAE4	SN: 601	03-Oct-23 (No. DAE4-601_Oct23)	Oct-24

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-22)	In house check: Oct-24
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24

	Name	Function	Signature
Calibrated by:	Paulo Pina	Laboratory Technician	
Approved by:	Sven Kühn	Technical Manager	

Issued: October 12, 2023

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

c) DASY System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.7 ± 6 %	1.40 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.92 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**39.8 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.25 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.0 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.1 ± 6 %	1.51 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.94 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**39.9 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.22 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.9 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.8 Ω + 5.9 jΩ
Return Loss	- 24.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.0 Ω + 5.8 jΩ
Return Loss	- 21.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.194 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

DASY5 Validation Report for Head TSL

Date: 06.10.2023

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d252

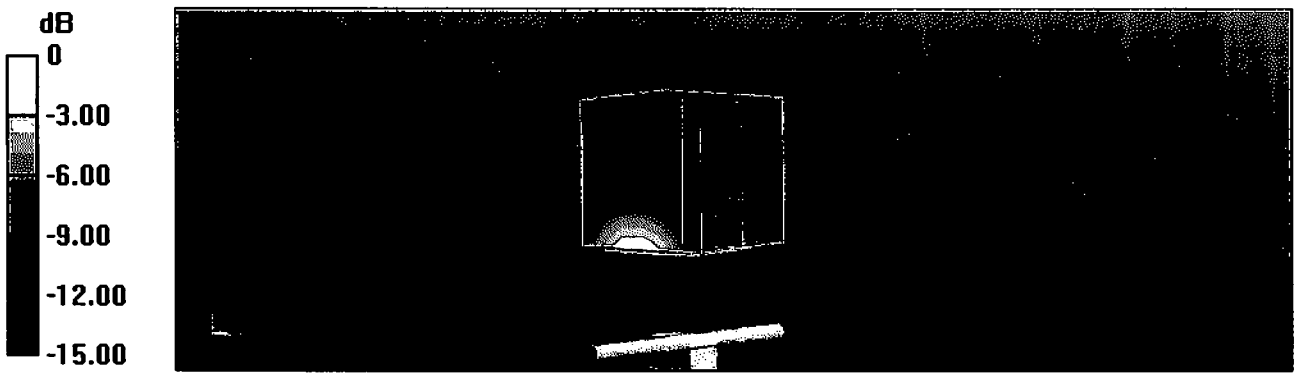
Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.4 S/m; ε_r = 40.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.43, 8.43, 8.43) @ 1900 MHz; Calibrated: 10.01.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 03.10.2023
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

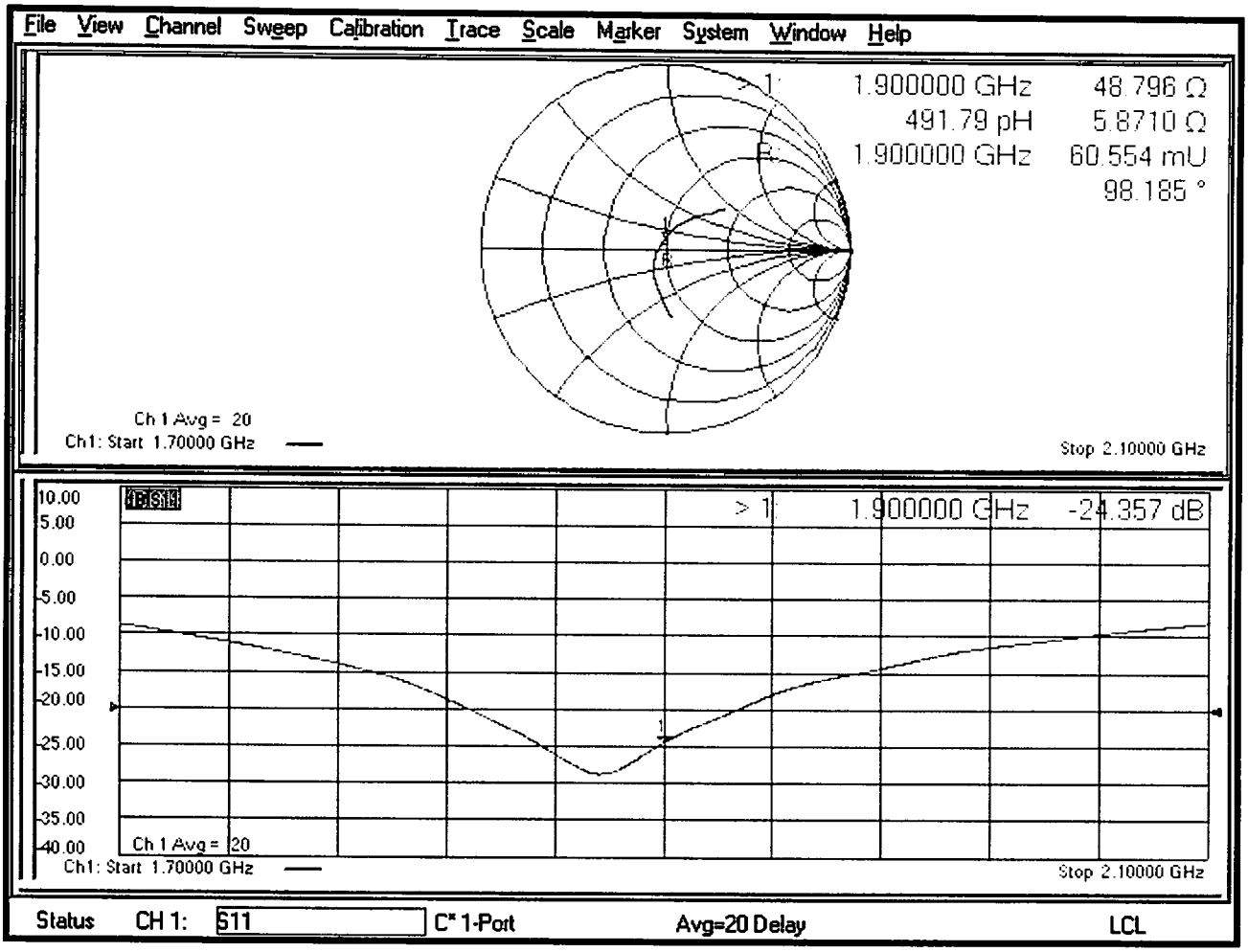
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 108.7 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 18.2 W/kg
SAR(1 g) = 9.92 W/kg; SAR(10 g) = 5.25 W/kg
Smallest distance from peaks to all points 3 dB below = 10 mm
Ratio of SAR at M2 to SAR at M1 = 55.9%
Maximum value of SAR (measured) = 15.0 W/kg



0 dB = 15.0 W/kg = 11.75 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 06.10.2023

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d252

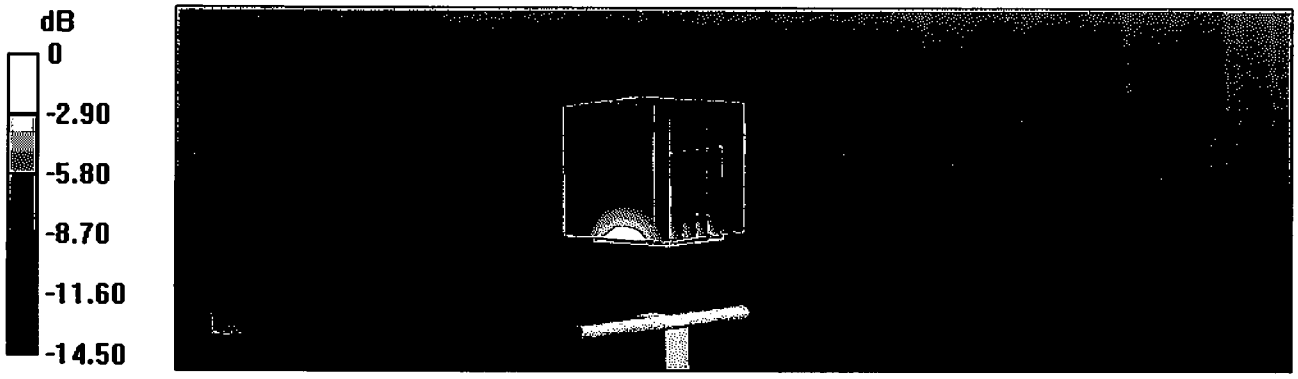
Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.51 S/m; ε_r = 53.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.42, 8.42, 8.42) @ 1900 MHz; Calibrated: 10.01.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 03.10.2023
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

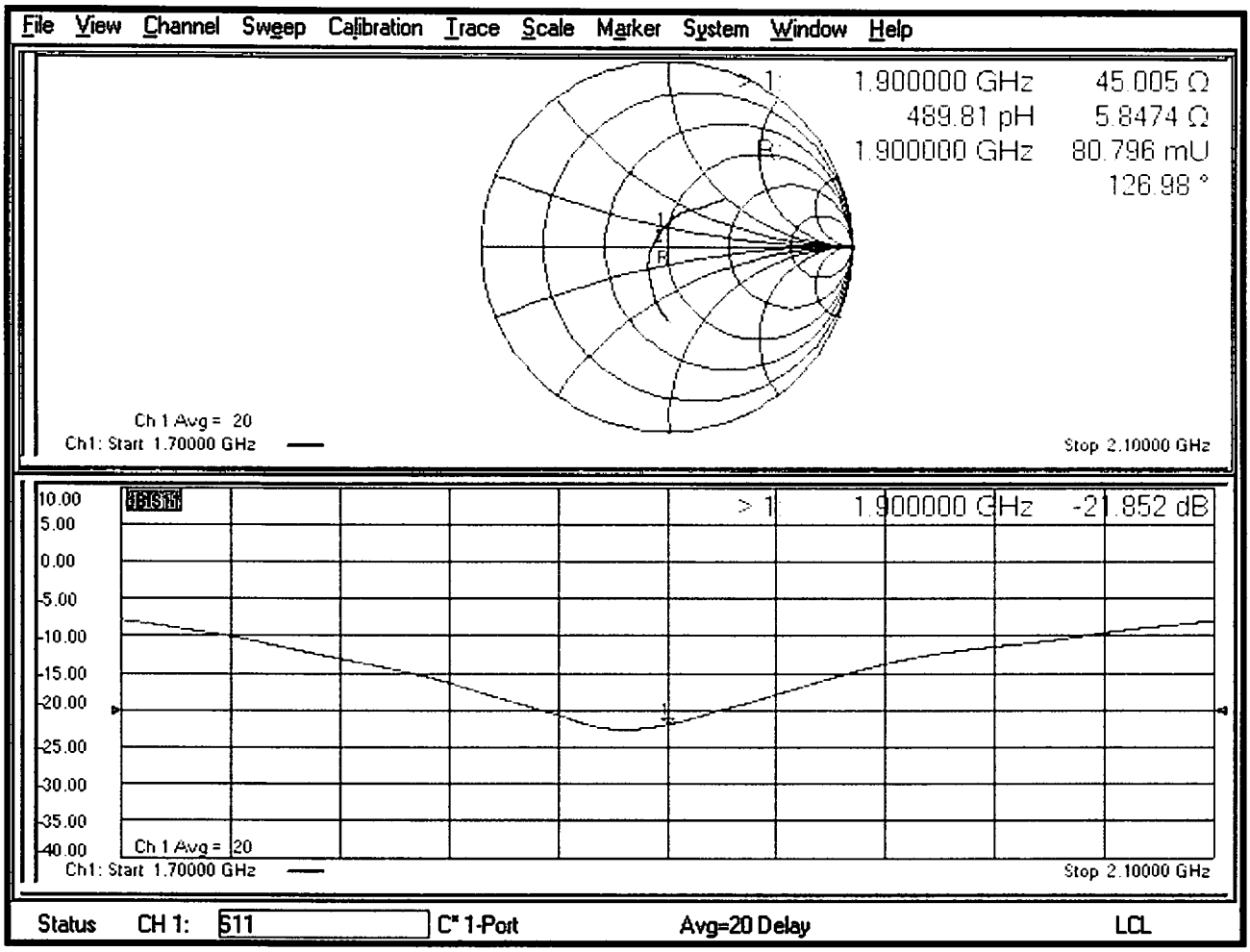
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 103.3 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 18.4 W/kg
SAR(1 g) = 9.94 W/kg; SAR(10 g) = 5.22 W/kg
Smallest distance from peaks to all points 3 dB below = 9 mm
Ratio of SAR at M2 to SAR at M1 = 55.5%
Maximum value of SAR (measured) = 15.2 W/kg



0 dB = 15.2 W/kg = 11.81 dBW/kg

Impedance Measurement Plot for Body TSL



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IN-HOUSE SAR VERIFICATION SOURCE CALIBRATION EXTENSION

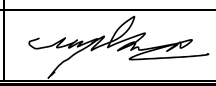
Object	D1900V2 – SN: 5d252
Description	SAR Validation Dipole at 1900 MHz
Procedure (s)	Procedure for SAR Verification Source Calibration Extension
In-house Check Date	11/7/2024

Equipment List

Manufacturer	Model	Description	Serial Number	Calibration Date	Calibration Due	CBT
Rohde & Schwarz	ZNL20	Vector Network Analyzer	101202	9/12/2024	9/12/2025	
Rohde & Schwarz	ZN-Z135	Calibration Kit	5000-309192839	10/31/24	10/31/26	
Control Company	4040	Ambient Thermometer	230581657	8/28/2023	8/28/2025	
Control Company	4352	Long Stem Liquid Thermometer	230662223	9/28/2023	9/28/2025	
Micro-Coax	UFB205A-0-0240-30x30	SMA M-F RF test Cable (DC - 18 GHz)	-			✓
Mini-Circuits	BW-N20W20+	20dB RF Fixed Attenuator (DC - 18 GHz)	-			✓
Mini-Circuits	NF-SF50+	RF Adapter N Male to SMA Female (DC - 18 GHz)	-			✓
SPEAG	DAE4ip	Data Acquisition Electrionics with Integ. Power	1839	8/14/2024	8/14/2025	
SPEAG	DAK-3.5	DAK-3.5 Dielectric Probe	1349	9/2/2024	9/2/2025	
SPEAG	EX3DV4	SAR Measurement Probe	7836	3/15/2024	3/15/2025	
SPEAG	Powersource1	Signal Generator	4341	1/5/2024	1/5/2025	

CBT: Components calibrated before testing. Prior to testing, the measurement paths containing a cable, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator, power sensor, or VNA) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.

Measurement Uncertainty = ±27% (k=2)

	Name	Function	Signature
Tested By:	Yue Li	Engineer	
Approved By:	Phuong Nguyen	Technical Manager	

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Per FCC KDB Publication 865664 D01, dipole can have longer calibration intervals of up to three years when it is demonstrated that the SAR target, impedance and return loss of the dipole have remained stable according to the following requirements:

1. Measured SAR does not deviate from the calibrated SAR value by more than 10%.
2. Return loss does not deviate by more than 20% from the previous measurement (i.e. value in dB x 0.2) and meet the required minimum return-loss.
3. Real and imaginary part of the impedance do not deviate by more than 5 Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have an extended calibration interval:

Dipole SN	Freq (MHz)	In-house Check Date	Cal Date	Head SAR target (1g) @ 30dBm (W/kg)	Measured Head SAR (1g) @ 17dBm (W/kg)	1g SAR Deviation (%)	Head SAR target (10g) @ 30dBm (W/kg)	Measured Head SAR (10g) @ 17dBm (W/kg)	10g SAR Deviation (%)	Cert Head Impedance (Ohm) - Real	Measured Head Impedance (Ohm) - Real	Head Impedance Deviation (Ohm) - Real	Cert Head Impedance (Ohm) - Imaginary	Measured Head Impedance (Ohm) - Imaginary	Head Impedance Deviation (Ohm) - Imaginary	Cert Head Return Loss (dB)	Measured Head Return Loss (dB)	Return Loss Deviation (%)	PASS/FAIL
5d252	1900	11/7/2024	10/6/2023	39.8	2.07	3.77%	21	1.08	2.61%	48.8	47.6	-1.2	5.9	5.7	-0.2	-24.4	-23.9	11.17%	PASS

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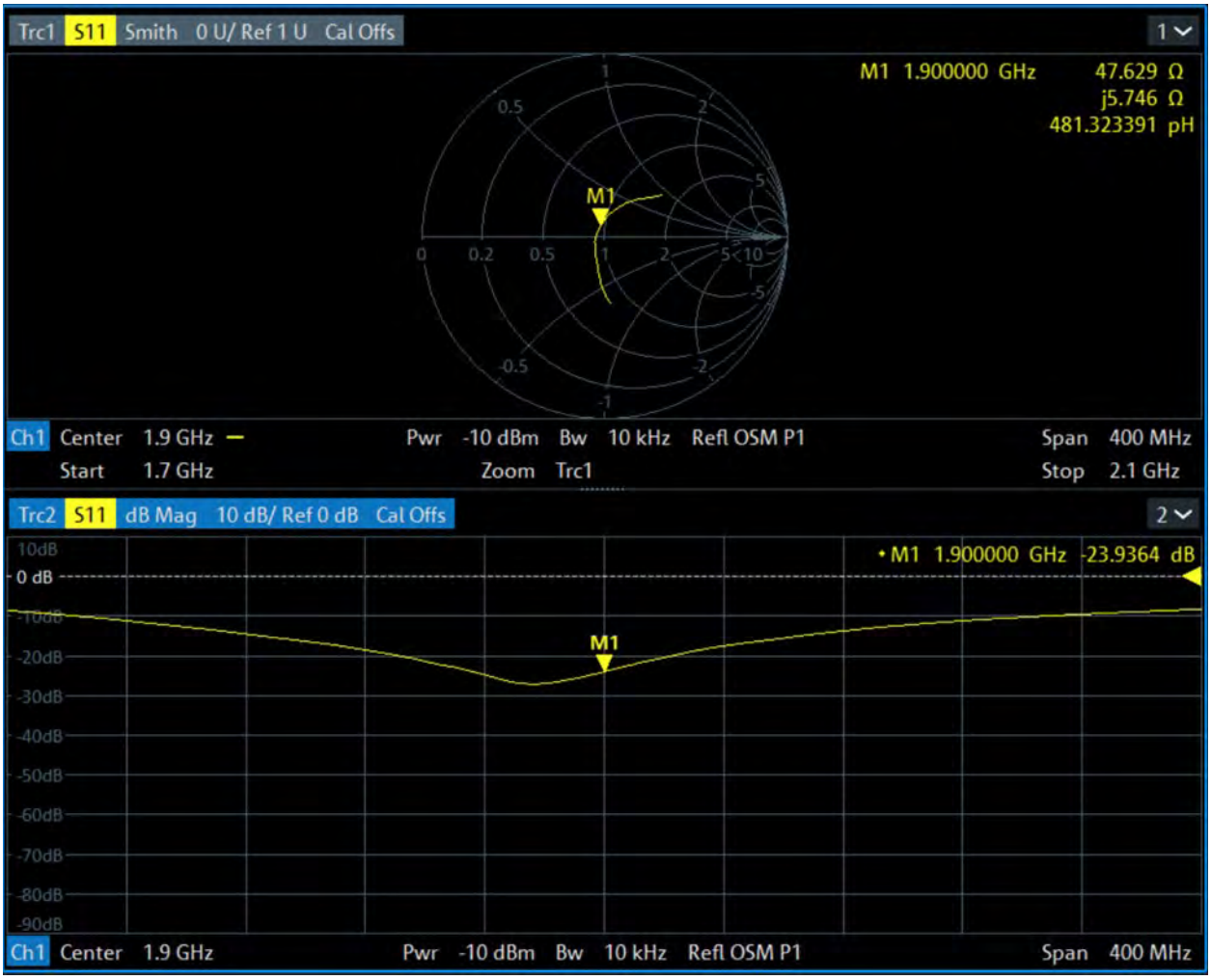
Impedance and Return-Loss Measurement Plot for Head TSL



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IN-HOUSE SAR VERIFICATION SOURCE CALIBRATION EXTENSION

Object	D1900V2 – SN: 5d252
Description	SAR Validation Dipole at 1900 MHz
Procedure (s)	Procedure for SAR Verification Source Calibration Extension
In-house Check Date	07/29/2025

Equipment List

Manufacturer	Model	Description	Serial Number	Calibration Date	Calibration Due	CBT
Rohde & Schwarz	ZNL20	Vector Network Analyzer	101202	9/12/2024	9/12/2025	
Rohde & Schwarz	ZN-Z135	Calibration Kit	5000-309192839	10/31/24	10/31/26	
Control Company	4040	Ambient Thermometer	230581657	8/28/2023	8/28/2025	
Control Company	4040	Ambient Thermometer	230581662	8/28/2023	8/28/2025	
Control Company	4352	Long Stem Liquid Thermometer	230662223	9/28/2023	9/28/2025	
Control Company	4352	Long Stem Liquid Thermometer	230662212	9/28/2023	9/28/2025	
Micro-Coax	UFB205A-0-0240-30x30	SMA M-F RF test Cable (DC - 18 GHz)	-			✓
Maury-Micro	360D	10dB RF Fixed Attenuator (DC - 18 GHz) + Short Circuit Termination	7799	12/28/2024	12/28/2025	
Huber+Suhner	SF126	High Performance RF Cable	570292/126			✓
SPEAG	DAE4ip	Data Acquisition Electronics with Integ. Power	1839	9/4/2024	9/4/2025	
SPEAG	DAK-3.5	DAK-3.5 Dielectric Probe	1349	9/2/2024	9/2/2025	
SPEAG	EX3DV4	SAR Measurement Probe	7836	9/12/2024	9/12/2025	
SPEAG	Powersource1	Signal Generator	4341	1/9/2025	1/9/2026	

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Measurement Uncertainty = ±27% (k=2)

	Name	Function	Signature
Tested By:	Yue Li	Engineer	
Approved By:	Phuong Nguyen	Technical Manager	

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The following dipole was checked to pass the above 3 requirements to have an extended calibration interval:

Dipole SN	Freq (MHz)	In-house Check Date	Cal Date	Head SAR target (1g) @ 30dBm (W/kg)	Measured Head SAR (1g) @ 17dBm (W/kg)	1g SAR Dev (%)	Head SAR target (10g) @ 30dBm (W/kg)	Measured Head SAR (10g) @ 17dBm (W/kg)	10g SAR Dev(%)	Cert Head Impedance (Ohm) - Real	Previous Head Impedance (Ohm) - Real	Measured Head Impedance (Ohm) - Real	Head Impedance Deviation (Ohm) - Real	Cert Head Impedance (Ohm) - Imaginary	Previous Head Impedance (Ohm) - Imaginary	Measured Head Impedance (Ohm) - Imaginary	Head Impedance Deviation (Ohm) - Imaginary	Cert Head Return Loss (dB)	Previous Head Return Loss (dB)	Measured Head Return Loss (dB)	Return Loss Dev (%)	PASS/FAIL
5d252	1900	11/7/2024	10/6/2023	39.8	2.07	3.77%	21	1.08	2.61%	48.8	48.8	47.6	-1.2	5.9	5.9	5.7	-0.2	-24.4	-24.4	-23.9	11.17%	PASS
5d252	1900	7/29/2025	10/6/2023	39.8	2.02	1.27%	21	1.06	0.71%	48.8	47.6	47.8	0.2	5.9	5.7	5.3	-0.4	-24.4	-23.9	-24.6	-15.64%	PASS

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Impedance and Return-Loss Measurement Plot for Head TSL